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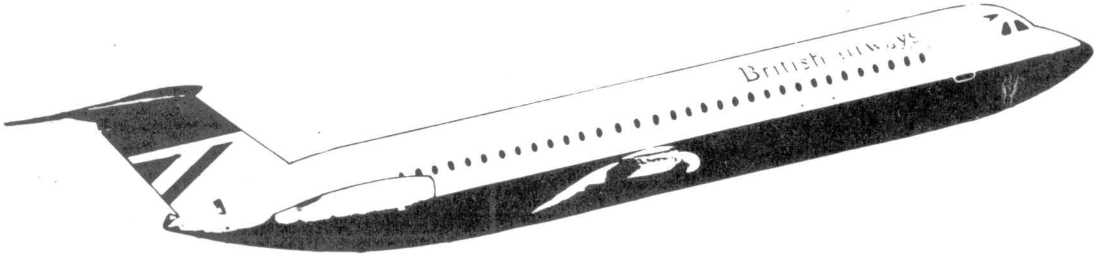
British airways

SUPER 1-11
OPERATIONS MANUAL
VOLUME 1

TECHNICAL

British
airways



Super 1-11

Operations Manual volume 1

Technical

Approved Technical Publication No 872 Serial No
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the Requirements of Engineering and Flight Operations

This manual complies with British Civil Airworthiness Requirements Section A, Chapter A6-7. The technical accuracy of the manual has been verified and is certified as correct.

Signed H. W. Owen. 15 May 1968
for Chief Project and Development Engineer, BEA.

A.R.B. Design Approval
No. AD/1160/48

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Pilots' Check List & Drills ...	ATP 870
Flight Management	ATP 871
Technical	ATP 872
Cabin Crew	ATP 873

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December 1986

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FLIGHT HANDLING

GENERAL

Control Forces

Aileron control forces on the ground are imposed by torsion bars, subsequent loads are proportional to the combination of aerodynamic loading and spring tab. Elevator and rudder forces in flight depend upon feel unit loads. For handling with partial/full manual reversion - see 'Abnormal Handling' section, Vol.1, Flight Management.

Damping

The aircraft has no artificial yaw damping, other than that provided when the auto-pilot is engaged. Dutch roll should not normally develop, and may be damped with normal control application.

Recommended Trimming Procedure

Care should be taken when trimming the rudder, as mis-trimming can significantly increase the total drag. The maximum amount of rudder trim during normal flight should be limited to ± 1 division of the trim scale. In engine-out and asymmetric fuel conditions more trim may be used, but care should be taken to avoid violent use of rudder, particularly at high speeds. The aileron trim is only properly effective provided that it is applied to overcome residual lateral stick force with the wings held level by the control wheel. If an attempt is made to trim the aircraft by using aileron trim alone to correct bank error, large amounts of trim could be applied with little or no apparent effect.

1. Autopilot - Disengage.
2. Emerg Elevator trim - Check indicated Zero.
3. Fly aircraft manually, wings level (Visual/FD reference).
4. Trim out rudder, aileron, elevator, in that order.
5. Check 3-axis trim indicator, turn and slip.

Stability and Trim Changes

Trim changes, due to operation of the undercarriage, speedbrakes, or changes of power, are small and are easily held with the control column.

Pitch changes due to operation of the flaps between 26° and 45° are large.

BEFORE STARTING

Check Lists

If any of the following apply, the full preliminary checks must be completed.

1. The Full Shutdown drill items have been actioned.
2. Defect rectification has been carried out, and the Captain cannot confirm that the rectified equipment has been fully pre-flighted and all affected switches and controls have been returned to the correct pre-flight positions.
3. First flight of the day.

Provided none of the above applies, the Turnround Checks may be used. When the aircraft has been vacated by the crew during the turnround, the full Turnround Check must be completed; if a pilot has remained aboard, or hand-over has been effected on the flight deck, the Turnround checks should be completed from item 18 and items 1 to 17 omitted.

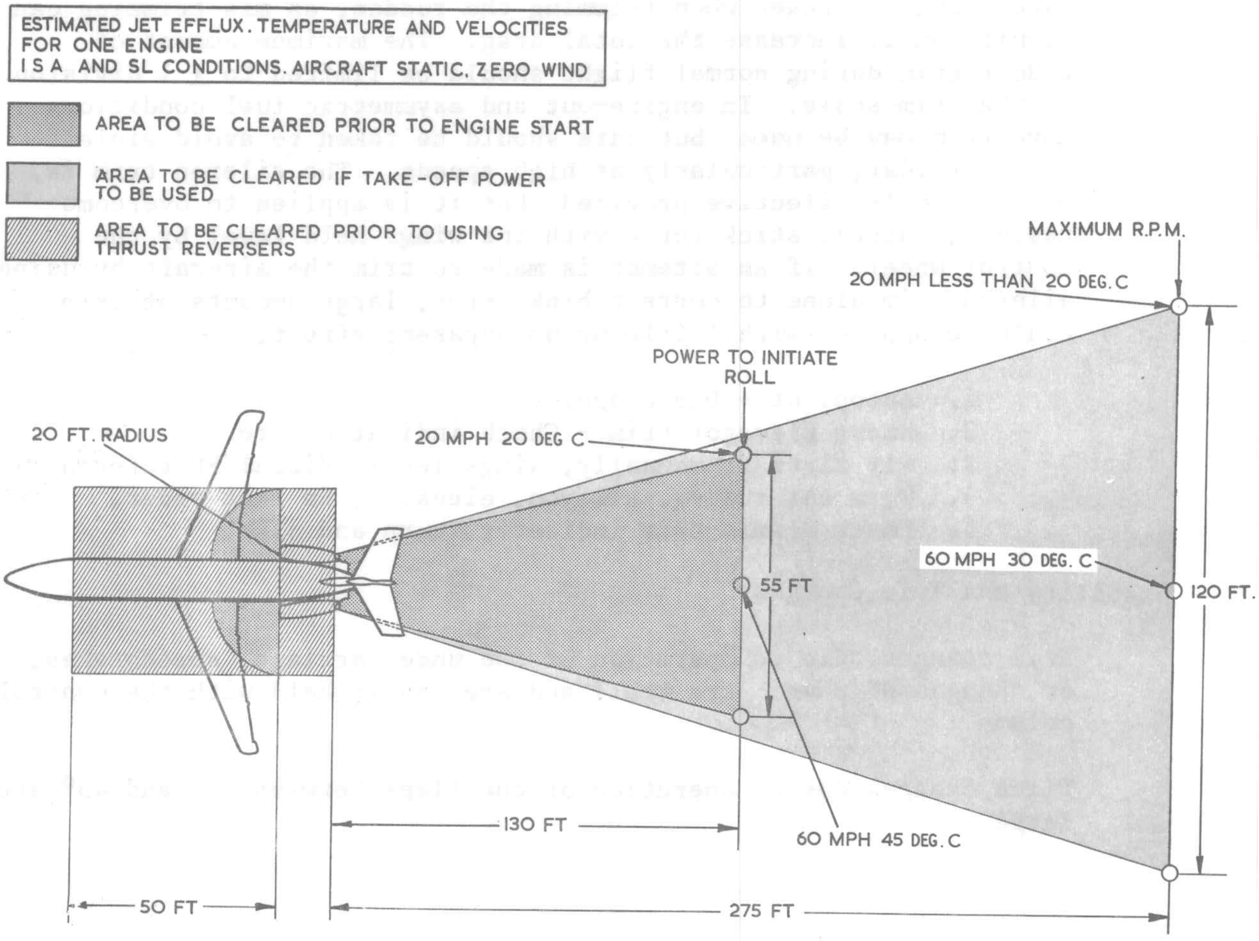
ESTIMATED JET EFFLUX. TEMPERATURE AND VELOCITIES FOR ONE ENGINE I S A AND SL CONDITIONS. AIRCRAFT STATIC. ZERO WIND
AREA TO BE CLEARED PRIOR TO ENGINE START
AREA TO BE CLEARED IF TAKE-OFF POWER TO BE USED
AREA TO BE CLEARED PRIOR TO USING THRUST REVERSERS
MAXIMUM R.P.M.
20 MPH LESS THAN 20 DEG. C
POWER TO INITIATE ROLL
20 FT. RADIUS
20 MPH 20 DEG C
60 MPH 30 DEG. C
55 FT
120 FT.
130 FT
60 MPH 45 DEG. C
50 FT
275 FT

FIG.1 JET EFFLUX DANGER AREAS

STARTING, PUSHBACK

The starting sequence will be actioned by the Co-pilot upon the Captain's command 'Start engines'. The Captain will ensure that the correct sequence is followed. The Co-pilot will report when both engines are stabilised. Use of the intercom between crew members should be avoided during push-back except in an emergency.

Tail Pipe Fires (flames)

If the engineer observes a tail pipe fire developing he will advise "Tail pipe flames observed No. .... engine". The objective is to direct the flight crew towards a tail pipe fire procedure rather than an engine fire procedure.

Tail pipe fires have not been a problem on Speys fitted to 1-11 aircraft. However, if tail pipe flames are observed then the recommended procedure is to keep the engine running and monitor the falmes. If there are other signs of engine malfunction (e.g. a fire warning) the appropriate drill should be carried out.

Start During Push-back:

1. The APU must be serviceable.
2. A continuous intercom link must be maintained between the Engineer and the Captain.

Push-Back Technique

Push-back may be initiated either whilst starting or after engine starting; starting during push-back will be the standard operation on pier stands, but the option to start before push remains where local conditions or taxiway congestion demand.

When the Captain advises that the aircraft is ready for start and push or for push-back, the Engineer will, having removed the GPU and chocks, check the taxiway is clear and call 'Release brakes'. The Captain will check the brakes are released and call 'Brakes released', ensuring that hands and feet are kept clear of the rudder bars and steering tillers.

The Engineer will not disconnect the towbar until both engines are started. In the event of a failure to start, or another fault that requires rectification, the Captain will call for the aircraft to be towed back to the stand. In the event of a fire warning during engine starting, the push-back will be stopped, the Engine/APU Fire on Starting drill completed, and the Captain will decide either to evacuate the aircraft on the spot or to tow back to the stand when safe to proceed.

When the aircraft has stopped after push-back, the Engineer will call 'Set brakes to park'. The Captain will apply the handbrake and call 'Brakes to park'. While the Engineer is reconnecting the torque links the steering handwheels and rudder pedals must not be touched. The Engineer will then disconnect his headset, giving a visual 'All clear' signal to the Captain when he is clear of the aircraft.

TAXYING

When taxying in confined spaces, exercise extreme caution, and where desirable ensure ground personnel are suitably positioned to render assistance. The minimum turning circles are illustrated in Fig. 2.

Before taxying, check foot brake pressures. With the nosewheel central, set 9,500 HP rpm, using steady even power application on both engines. If necessary increase power until the aircraft moves. Avoid bursts of unnecessarily high power; normally 10,500 HP rpm should be sufficient, but up to 11,000 HP rpm may be used. Ensure the blast is directed away from working areas, and always remember the strength of the jet efflux (see Fig 1.). After breakaway and when taxying speed is attained, set engine rpm as required.

Whenever power in excess of 9,000 HP rpm is required to maintain taxying, following unusually high rpm to initiate taxy roll, the aircraft should be returned for a brake inspection and rpm values recorded in the Tech Log.

When engine anticing is required for taxying (see Leading Particulars and Limitations, 'Ice & Rain Protection', Flight Management), and the temperature is below +1° it is important to ensure adequate protection by increasing HP rpm up to 11,000 for periods of 5 seconds at intervals of not more than 8 minutes. Excess speed must be avoided, and blast precautions observed.

Before initiating a full hand wheel turn, ensure that aircraft speed has reduced sufficiently to require no further braking during the turn. If during a full hand wheel turn, the nosewheel castors further round than the maximum that the handwheel is capable of setting, then coarse use of rudder and brakes will be necessary to return the nosewheel within the range so that the handwheel is again in control. After completing the turn, centralise the nosewheel before applying final brakes.

Taxy the aircraft at a speed which will permit the cabin crew to carry out their duties safely. Particular care must be taken when cornering, braking or traversing uneven taxyways.

Always use the brakes as little as possible during taxying and, when stopping, ensure the aircraft is stationary before applying the parking brakes. Use of reverse thrust to manoeuvre or retard the aircraft is not permitted during taxying, except in emergency as detailed in 'Ice and Rain Protection', Vol 1, Flight Management or ground test as called for in Taxying Drills.

The 'Taxying' Drills should be commenced as soon as the aircraft is clear of the parking area, but attention to these Drills must not be allowed to jeopardize the safety of the aircraft by diverting the look-out of both Captain and Co-pilot simultaneously.

Turn off lamps should be switched on when taxying and only switched off when passing FL100 during the climb. They should be switched on at FL100 during the descent and switched off again when parking at the destination.

At night, landing and turn-off lights should be used at all times. In low visibility taxy slowly and with extreme caution, particularly when the visibility is less than 200m; when external visual clues are scarce, occasional glances through the side windows should assist in gauging speed which could otherwise increase unnoticed. Use all available means to increase flight deck vision (windscreen wipers, landing and turn-off lights etc), and aim to taxy at a speed that will ensure a stop can always be made within the range of forward visibility.

At the end of the runway immediately before take-off the Captain may call for an engineer to carry out a check for ice on those surfaces of the aircraft which are visible from the ground but not from within the aircraft.

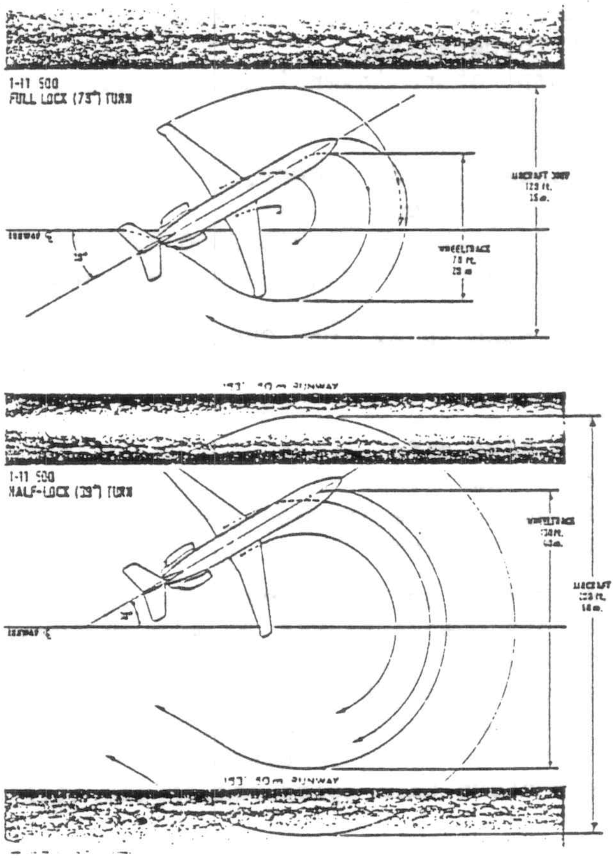

FIG.2 MINIMUM AND RECOMMENDED TURNING CIRCLES

TAKE-OFF

Weather Minima

If the weather at the departure airfield is below Cat 1 or appropriate non precision weather minima, a suitable diversion airfield offering Cat 1 minima or better must be available within 60 minutes flying time at single-engined speeds (approx 250 nm). This requirement does not prevent the Captain electing to carry out a Cat 2 AOM asymmetric approach following an engine failure on take-off or in the climb.

Take-off Thrust Settings

'Full Throttle' thrust - thrust when throttle lever is fully forward, as used after engine failure during take-off, for overshoot and for take-off in snow, slush, or standing water when special Performance Manual data is used.

'Standard' take-off thrust - thrust used for take-off when no thrust reduction is being applied.

Extract the standard thrust index from the Check Lists Charts and set the thrust indices to this figure.

'Reduced' take-off thrust - thrust used when applying any thrust reduction procedure, and should be used whenever runway, airfield and other conditions permit. Reduced thrust must not be used when:

1. Runway is slippery, or covered with snow, slush or standing water.
2. The performance summary specifies the use of Standard Thrust for the runway.
3. Either or both thrust reversers, lift dump, or any part of the braking system is inoperative.
4. A large surface temperature inversion is present, i.e. 1° or more per 100ft.
5. Windshear is reported.
6. The airfield altitude exceeds 3000ft.
7. The tailwind component exceeds 10 kt.
8. The actual take-off weight is within 2000 kgs. of the maximum performance limited take-off weight for the runway/temperature/flap setting.

Extract the standard thrust index from Check List Charts, reduce by 30 units and set the thrust indices to the reduced value.

Noise Abatement Power:

75% for reduced thrust take-offs

70% for standard thrust take-offs.

Set the thrust gauge bugs to the appropriate position depending whether or not reduced thrust is to be used.

'Take-off power' This term is to be reserved for the call confirming that the appropriate power has been achieved on both engines. The other engine instruments are checked after this call has been made. The minimum acceptable thrust for any take-off is 100% indicated on both engines by 60 kt, and although the indicated thrust will increase by about 2% during the take-off run the take-off must be abandoned if less than 100% is indicated at 60 kt; above this speed ram effect will start to increase indicated thrust.

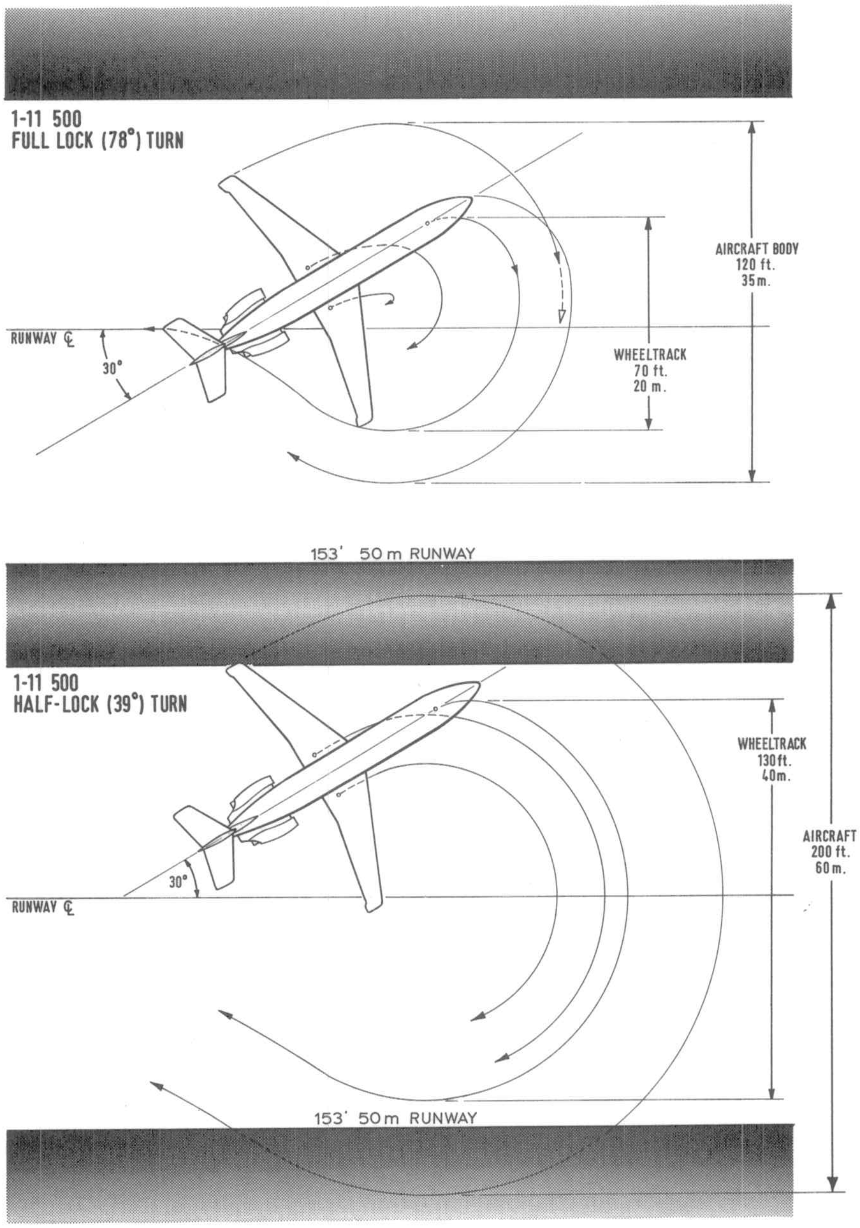

FIG.2 MINIMUM AND RECOMMENDED TURNING CIRCLES

TAKE-OFF

Weather Minima

If the weather at the departure airfield is below Cat.1 weather minima, a suitable diversion airfield offering Cat.1 minima or better must be available within 60 minutes flying time at single-engined speeds (approx 260 nm).

/Cont'd. ...

The time taken for the aircraft to reach 60 kt, from either a rolling or standing start, normally provides for:

1. Engine acceleration time.
2. Stabilisation of engine indications, including % thrust.
3. Achievement of normal operating temperatures within the engines.
4. Adjustment of power setting to achieve 100%.

If an engine fails to achieve 100% with a standard thrust index setting, take-off must not be attempted with a reduced thrust index in order to achieve 100%.

Check Start

If the Captain has good cause to suspect that a particular engine might be sluggish (first flight, Tech Log history), he may elect to use the Engine Check Start procedure, subject to consideration of:

1. Airport noise sensitivity and effects of jet blast.
2. Slippery runway.

Take-Off Flap Setting

Use 18° flap in preference to 8° for take-off, unless this would preclude the use of reduced take-off thrust. Use the flap setting to give a thrust reduction of 30 units whenever possible.

Normal Take-Off

Establish V_1, V_R and V_2 and V_{FU}; set both inner ASI indices to V_2, and outer indices to V_1 and V_{FU}. Extract and set the take-off thrust index to be used.

A rolling start should be used provided that ATC clearance has been received before or whilst entering the runway and:

1. Runway surface free of snow, slush or standing water.
2. Either: The runway length is in excess of 3,200 m, and the ambient temperature ISA + 10°C or below,
   Or: Actual weight is lower than max runway permitted take-off weight by:
   No thrust index reduction - 200 kg or more.
   Reduction of 30 units - 2,200 kg or more.

Rolling Start:- Enter the runway and line up, setting 9,000 HP rpm during the turn on, and then open the throttles to Take-off power without delay.

Standing Start:- Enter the runway, line up, and apply the parking brake. When take-off clearance is received, release the brakes, and open the throttles to Take-off power without delay.

Engine Check Start:- Enter the runway, line up, and apply the parking brake. When take-off clearance is received, open the throttles to Take-off power without delay, check 100% is indicated on both engines, and release the brakes. The aircraft must not be allowed to move forward with the brakes on. Do not take-off if 100% is not achieved on both engines.

During take-off roll:- Check brake pressures zero, and start the stop watches as the aircraft starts to roll. Maintain light forward pressure on the control column until V_R. During the take-off run the indicated thrust will increase by approx 2% - do not reduce the throttle settings to maintain 100%. Check all engine indications are within the normal limits and check that the HP rpm is commensurate with the take-off power indicated by the thrust gauges.

Maintain directional control by rudder fine steering. Initiate rotation at V_R by a firm rearward movement of the control column, and establish an attitude of 10° nose up (12° - 13° nose up for 8° flap take-off).
Do not exceed V_2 + 30 kt below 100 ft. Retract the undercarriage when a positive climb indication is observed on the altimeter and VSI.

Take-off through Water, Slush or Snow

Whenever these conditions are present, refer to the limits given in 'Ice and Rain Protection' section, Flight Management.
Maximum crosswind components are listed in Check Lists and Drills.

Low Visibility

With the aircraft aligned on the runway, Captains are required to confirm that the actual visibility at the threshold corresponds with the reported RVR. (In 125m RVR it should be possible to see 6 centreline lights at 15m spacing or 3 at 30m spacing.) Captains should consider runway state and braking action before taking-off in reduced visibility conditions, and take care to rotate at the normal rate when taking-off in such conditions.

Crosswind Take-off

The technique is the same as for a normal take-off. Unstick must be positive to prevent touching down with drift. To keep the wings level a little up-aileron may be applied on the into-wind wing but not enough to extend the spoilers; at unstick centralise smoothly during rotation.
Maximum crosswind components are listed in Check Lists & Drills.

Severe Turbulence

Do not take-off if severe turbulence is forecast or expected to be encountered immediately after take-off, before it is possible to retract the flaps and accelerate to the Rough Air Speed.
If the flaps are at 8° or 18°, and severe turbulence is met unexpectedly, they must be left extended: make every endeavour to achieve and hold the speed between 180 and 210 kts IAS.

INITIAL CLIMB

Monitor flight instruments, avoiding concentration on any one instrument.

During the brief period below 500 ft only an emergency requiring immediate attention should be allowed to interrupt the close monitoring of the flight instruments.

Hold the initial attitude of 10° nose up (12° - 13° nose up for 8° flap take-off), until V_{FU} is achieved.
At 500 ft:
1. Check V_{FU} is achieved.
2. Select 0° flap.
3. Set 75% / 70% thrust.

If at 500 ft the speed is below V_{FU} (18° flap take-off):
1. Check speed is within 10 kt of V_{FU}.
2. Select 8° flap.
3. Check V_{FU} is achieved.
4. Select 0° flap.
5. Set 75% / 70% thrust.

Rotate the aircraft to an attitude of 15°-20° nose up and maintain V_{FU}. Do not exceed 20° nose up.
If the speed decays below V_{FU} after flap retraction, restrict bank angle to 15° until V_{FU} is restored.
At 1500 ft select airconditioning from engine air and select airframe anticing if required.
Adjust throttles to maintain 75% / 70% thrust.
At 4000 ft set climb power and start accelerating maintaining about 1000 ft per min ROC. An attitude of 6°-8° nose up is required.

At some noise-sensitive airfields the noise abatement climb will continue to a height above 4,000 ft. This height is annotated for the particular runway in the Airfield Performance Summary, Performance Manual. In these cases delay the start of the Climb Drills accordingly.

Maintain 240 kt until both pilots have checked the flaps are at zero and then accelerate to the appropriate en-route climb speed.

After setting Climb Power, the autopilot should be engaged as soon as convenient and, if necessary, initially controlled on pitch control, until the speed lock is engaged.

The noise abatement technique may be disregarded at the Captain's discretion in conditions of turbulence, icing etc. Flap retractions and power reduction can be delayed, until speed and altitude are adequate.

The APU will normally be shut down on all sectors at the appropriate point in the Climb Drills, and restarted during approach if required.

EN-ROUTE CLIMB

Standard Procedures

Climb at 280 kt until the anticipated cruise Mach No is reached, then climb at this speed.

Thereafter only reduce speed to maintain 500'/min rate of climb. Climbing at lower speeds causes a fuel and time penalty.

Maximum Rate of Climb

Climb at 250 kt/MIND 0.64 to the required cruise level.

Maximum Gradient Climb

Climb at the En-Route Climb speed (ERC).

Operational Necessity Climb Power (12,150 HP rpm, 510°C)

This may be used for short periods only:

1. To meet ATC requirements.
2. To achieve a higher than normal cruise level, in order to increase clearance over terrain or adverse weather.

Where possible, it is preferable to reduce to maximum rate of climb speed to meet the above requirement, rather than to use Operational Necessity Climb power. In extreme conditions it may be necessary to use Operational Necessity Climb power and maximum rate of climb speed, or a higher speed as dictated by turbulent conditions. Under these circumstances FL350 will normally be reached within the 300 ft/minute ceiling.

Fuel Management

Maintain both booster pumps on in each wing tank. When fuel has to be transferred from the centre-section tank, switch on both transfer pumps before selecting transfer cock switches to open.

CRUISE PROCEDURES

Normal Cruise

Normal climb power may be maintained for up to five minutes during level acceleration to the required cruise speed.

The normal cruise speeds are:

Flight levels up to FL190 - 300 kt IAS.

FL200 to FL300 -	M_{IND} 0.64 at FL200, increasing by M_{IND} 0.01 per 1,000 ft up to M_{IND} 0.74 at FL300 .
Above FL300 -	M_{IND} 0.74.

For cruise levels up to and including FL190 reduce power to maintain 300 kt.

If the cruise is to be made at FL200 or above, extract the appropriate Cruise Thrust index from Charts 5 during the latter part of the climb, and set this on the thrust gauges. On reaching the required Flight Level accelerate to the required cruise speed, and then reduce the power to 70% observing the normal cruise engine limitations. The thrust index should be updated after each hour of cruise to compensate for the decrease in weight. If this cruise speed is not maintained within ± 0.02M complete an Engineering Performance Report, form E1449.

If the cruise speed cannot be achieved without exceeding the cruise power limitations, set cruise power and maintain the speed which is achieved at that power.

In turbulence reduce to and maintain the appropriate Rough Air Speed.

Maximum Range Cruise

Maintain 99% Best Range speed - See Vol.1, Fight Management.

/Cont'd. ...

Head/Tailwinds

Strong headwinds will increase sector times and should lead to consideration of requesting a higher flight level. Climb, cruise, and descent speeds should not be increased to counter headwinds, as this will increase the fuel consumed per nautical mile. With strong tailwinds, reduction of cruise and descent speeds to the 99% Best Range speed will decrease fuel consumed per nautical mile whilst giving equivalent groundspeeds. Air Traffic Control should be advised of any deviations from the flight plan. Lower cruise speeds at higher levels may lead to overtaking and hence ATC reclearance to lower levels.

Wind Gradient

It is always beneficial to cruise at a higher level provided the headwind component increases by less than 5 kt per 1,000 ft. Conversely, cruise at a lower level is beneficial if the headwind component decreases by more than 5 kt per 1,000 ft.

Thunderstorms and Severe Turbulence

Thunderstorms and areas of severe turbulence of thunderstorm intensity should be avoided whenever possible. Use airborne weather radar as a means of detecting and avoiding turbulence cells. Use ground radar assistance when available or visual means whenever possible. Endeavour to avoid 'echoes' by a margin of 10 miles, but where the 'echoes' indicate a steep rainfall gradient, increase the margin to 15 miles between 20,000 and 25,000 feet and to 20 miles above 25,000 feet.

When penetration of such areas is unavoidable, prepare the aircraft in advance: use the speedbrakes to reduce speed to the Rough Air Speed, and retract when speed is achieved. Adjust power appropriately and note the tailplane trim setting. Do not vary the power during the turbulence encounter.

Use of the autopilot is recommended as the best method of maintaining attitude during turbulence. Speed, auto-throttle, and height locks, must not be used. Make sure that the attitude is correct at the moment when these locks are disengaged because the autopilot will now control the aircraft to this attitude and the pitch control facility must not be used. Monitor the tailplane trim setting during the encounter and should it be necessary to disconnect the autopilot, ensure that the trim is returned to its original rough air speed setting. Monitor autopilot operation by the attitude director.

If turbulence is encountered unexpectedly, maintain the same speed provided it is within ± 10 kt IAS or 0.02M of the Rough Air speed. Do not disengage the locks unless satisfied that the aircraft is in a correct attitude.

If it becomes necessary to take over manual control of the aircraft, aim to maintain a normal attitude using moderate and smooth elevator movements. Do not attempt to chase airspeed or height. Do not change power or trim. Avoid turns; a straight course is the quickest way out but if a manoeuvre is essential make it gently.

Select engine and airframe anticing switches 'On', except in clear air turbulence. If negative 'g' is experienced, temporary warnings, e.g. low oil pressure may occur.

Light to Moderate Turbulence

Flight should continue with the autopilot in use; there is no limitation on the use of speed and height locks; however, light turbulence should be taken as a warning of possibly imminent severe turbulence, therefore be prepared to disengage the locks. A change in flight level or a reduction in speed may provide more comfort.

PRE-DESCENT

Extract the 45° flap or 26° flap V_{AT} as appropriate: set both inner ASI indices to the V_{AT}, and both outer indices to V_{AT} + 10 kt.. For index settings applicable to landings in abnormal situations, see Abnormal Handling chapter, Flight Management.

DESCENT

Thunderstorms or Turbulence in the Landing Area

If thunderstorms exist over or in the vicinity of the landing airfield, or landing reports indicate heavy turbulence, consider delaying in the holding pattern or diverting if the storm is likely to be prolonged. Indicated speed fluctuations in the order of ± 15 kt may be expected.

Standard Procedure

Reduce power to between 9,300 and 10,000 HP rpm, and descend at 300 kt. If the aircraft has been flying at a cruise Mach number, maintain that Mach number during the descent until 300 kt is achieved, then continue at 300 kt. With the aircraft clean, a descent rate of about 2,500 ft/min will be achieved. To increase the descent rate reduce power to flight idle (if clear of icing), use a higher IAS or extend speedbrakes in that preference order. Where possible, the descent path should be planned to enable the Cruise Mach/300 kt technique to be used. If the speed is increased to achieve a higher descent rate, then a maximum of V_{MO}/M_{MO} is permissible in smooth conditions.

The APU will be started at the appropriate point in the Below FL150 drills only if the weather conditions are considered adverse (cloud base approaching circling minima) or as determined by the APU limitations, Vol.1, Flight Management.

Emergency Descent. See Check Lists and Drills

Steep Descents

Above FL150

With Flight Idle power, speedbrakes 20° and M_{IND} 0.77/300 kt, the rate of descent will be approximately 5,500 ft/minute; at 250 kt the descent rate will be reduced to approximately 3,000 ft/minute.

Below FL150

The steepest descent gradient will be achieved with Flight Idle power, speedbrakes 50°, and 300 kt IAS. At speeds below 300 kt the steepest gradient is achieved at 240 kt, approximately 4,000 ft/minute; speed increase from 240 kt decreases the descent gradient, through speedbrake blow-back, up to 290 kt. Above 290 kt the descent gradient increases.

With Flight Idle power, speedbrakes 50°, and 200 kt IAS, the rate of descent will be approximately 2,500 ft/minute.

Approaching Safety Height + 3,000 ft.

Reduce the rate of descent to 2,000 ft/minute maximum. Speed must be reduced to 240 kt when approaching the main entry beacon or when the aircraft is within 20nm of touchdown. A progressive speed reduction should be made, initially flying at 210 kt, aircraft clean,

APPROACH

The speeds quoted in this section are those to be flown in normal conditions. Should moderate or severe turbulence be encountered, the approach speed may be increased by 5 kt, but the aim is still to achieve V_{AT} + 10 kt at the threshold.

General

If an approach is to be made to a runway equipped with a serviceable ILS in weather conditions requiring a Monitored Approach, an automatic approach must be carried out if the aircraft systems are operating satisfactorily; if the autopilot is not fully serviceable, complete a manual FD approach or manual instrument approach on basic instruments as appropriate, observing the relevant weather minima.

When making an approach, an overshoot must be carried out immediately the decision height is reached unless sufficient visual reference is available to continue by visual means alone. The autopilot may remain engaged to the appropriate disconnect height.

Autopilot disengagement must always be confirmed, by checking that the A/P MI shows Off; if the MI reverts to ENG, select the A-Pilot switch to Kill immediately.

Overshoot immediately if a discrepancy arises between the ILS/VOR centre line displays on the two flight compasses, unless this discrepancy can be resolved by other means e.g. visual reference or radar.

ASI Indices

Using data from the reference speed booklet for the estimated landing weight, set the inner ASI index to V_{AT} + 10 and the outer indices to V_{AT} and V_{FU}.

Radio Decision Heights

Radio Decision Heights will always be used for Category 2 or 3A approaches. Radio Decision Heights, when promulgated, will be used for Category 1 auto approaches. If an auto approach cannot be flown, or an auto approach becomes a manual approach, the Servo Decision Height must be used.

Autothrottle

Speed and autothrottle performance must be closely monitored whenever autothrottle is engaged.

Autothrottle may be engaged on entering the holding pattern, or on reaching the intermediate approach speed of 170 kt (when cleared without a hold).

For a Cat 2 or 3A approach, or an approach terminating in an autoland, autothrottle must be used on final approach and engaged, at the latest, once flaps have been lowered to 26° and the speed stabilised at V_{AT} + 20 kt. Autothrottle will be disengaged when crossing the runway threshold, unless autolanding. When autolanding, disengage the autopilot and auto throttle simultaneously on touchdown.

In the event of excessive autothrottle activity due to turbulent conditions, revert to manual throttle operation and, where necessary, a Cat 1 approach.

If achieved IAS deviates substantially from the selected speed, and an automatic disconnect does not occur, disengage the autothrottle.

If the autothrottle disengages, the power should be set immediately to 11,000 HP rpm before adjusting the power further for speed corrections.

When autothrottle is engaged and either the autopilot is engaged, but not coupled to a height lock or glideslope, or the aircraft is being hand flown, a disturbance may cause a divergence from the flight path without the resultant speed change which would tend, if the throttles were fixed, to restore the trimmed condition. The rate of descent and attitude must therefore be closely monitored when flying with autothrottle engaged without adequate flight path reference or control, to avoid the rapid build up of high rates of descent. In addition any change in dialled speed must be followed by adjustment of pitch attitude.

If achieved IAS deviates substantially from the selected speed, and an automatic disconnect does not occur, disengage the autothrottle.

If the autothrottle disengages, the power should be set immediately to 11,000 rpm before adjusting the power further for speed corrections; the power should normally be set by the Handling pilot, backed up by the Non-Handling pilot.

When autothrottle is engaged and either the autopilot is engaged, but not coupled to a height lock or glideslope, or the aircraft is being hand flown, a disturbance may cause a divergence from the flight path without the resultant speed change which would tend, if the throttles were fixed, to restore the trimmed condition. The rate of descent and attitude must therefore be closely monitored when flying with autothrottle engaged without adequate flight path reference or control, to avoid the rapid build up of high descent rates. In addition any change in dialled speed must be followed by adjustment of pitch attitude.

Flight Compass Displays During Approach

Overshoot immediately if a discrepancy arises between the ILS/VOR centre line displays on the two flight compasses, unless this discrepancy can be resolved by other means e.g. visual reference or radar.

Radio Decision Heights

Radio Decision Heights will always be used for Category 2 approaches. Radio Decision Heights, when promulgated, will be used for Category 1 auto approaches. If an auto approach cannot be flown, or an auto approach becomes a manual approach, Servo Decision Height must be used.

Set the Radio Altimeter indices to the appropriate Radio Decision Height, and set the Cat.1 Servo Decision height on the Servo Altimeter. Before commencing descent, test the Radio Altimeter and check the approach profile.

Intermediate Approach

Fly at 170 kt with 18° Flap.

ILS Approach with GP - Automatic or Manual

Maintain 170 kt with flap 18° and undercarriage Up, and establish on the localiser. When the final intercept heading is less than 45° from the inbound QDM, do not select the coupling switch to Track until established on the localiser.

Intercepting the GP in Level Flight:

Maintain speed and configuration until GP capture, select U/C Down, and reduce to 160 kt; descending through 2,000 ft QFE, select 26° flap and reduce to V_{AT} + 20 kt; at 1,500 ft QFE, select 45° flap and reduce to V_{AT} + 10 kt and maintain to the threshold.

If the localiser capture height is 2,000 ft QFE or below, it may be necessary to lower the U/C and reduce to V_{AT} + 30 kt prior to GP capture. It may also be necessary to lower 26° flap and reduce to V_{AT} + 20 kt as the GP moves off the stop.

Intercepting the GP from Above:

Use the above configuration and speed changes.

Final Approach:

If making an automatic approach, select Prime Land or Glide Gearing at 1,200 ft QFE; if the speed is not stabilised by 1,200 ft, the selection should be made not later than 800 ft QFE.

Cloud-break:

When an ILS approach is to be followed by a visual circuit, lower the U/C, maintain 18° flap, and fly the visual circuit at 160 kt until established on base leg or turning finals. Inhibit the GPWS G/P before reaching 500 ft R.

Approaching Decision Height:

Assess steadiness of the approach and aircraft positioning, by visual reference or from the displays; if unsatisfactory, disconnect the autopilot, if engaged, and fly the aircraft manually, and either continue the approach by visual reference or continue the instrument approach down to the Cat.1 decision height using the flight director, or overshoot immediately.

If an autoapproach is satisfactory, and visual reference for a continued approach has been established by decision height, the autopilot may remain engaged down to the minimum autopilot disengage height - see FCS and Radio section, Vol.1, Flight Management.

For all autoapproaches which require manual takeover because of poor localiser holding, the subsequent judgement of height and control in the pitch axis is the more difficult task in marginal visibility, during the later stages of the approach. Therefore, use all aids available, e.g. F/Dir in pitch, VASI's and Approach Lighting. Be particularly careful to note Pitch Attitude on the ATT/DIRS before disengagement and do not allow nose to drop inadvertently after Autopilot Disengagement.

NOTE: An auto-disconnect may occur if Prime Land is selected within 15 seconds of GP capture.

ILS (No GP), Back-beam ILS, VOR approach, Beacon approach

For No GP and Back-beam ILS, inhibit the GPWS GP before reaching 500 ft R.

Intermediate Approach:

Maintain 170 kt with flaps 18°, reducing to 160 kt with U/C Down when on intercept heading or final heading.

When the approach is to be followed by a visual circuit, leave the flaps at 18° and U/C Down; fly the visual circuit at 160 kt until on base leg or turning finals.

Straight-In Approach from Beacon/Fan:

When established on final approach, level or descending, and before reaching the beacon/fan:-

1. Select flaps 26°.
2. Reduce to V_{AT} + 20 kt.

The Autopilot must be disconnected for descent below 1,000 ft QFE.

/Cont'd. ...

At the Beacon/Fan:-

3. Start stopwatch.
4. Set pre-calculated rate-of-descent, using VSI.
5. Select flaps 45°.
6. Reduce speed to V_{AT} + 10 kt and maintain to the threshold.
7. Check the achieved rate of descent on altimeter against stopwatch, and if necessary correct it.

At 1,000 ft QFE if on ILS back-beam or VOR approach:-

8. Put steering index under the lubber line.
9. Select radio coupling switch to 'Steering'.
10. Any necessary alterations, by reference to Visual Display or a beacon, should be made by moving the steering index.

NOTE: The Second Pilot must continuously monitor the beacon identification signal throughout.

Radar Approach

The Captain is responsible for maintaining safe terrain clearance during radar-controlled Initial and Final Approaches. Requests for position checks should be made to the Radar Controller at regular intervals, and full use made of the other navigational aids available for continuous cross-checking.

Note - charts are available for Radar Vectoring areas at some airfields.

PAR and SRA approach:-

Maintain 170 kt with flaps 18°. When on intercept heading, lower the undercarriage and reduce to 160 kt IAS.

When instructed by the Controller to commence descent on a 3° glide slope, disconnect the autopilot and descent at 160 kt.
On passing 2,000 ft QFE:

1. Select flaps 26°.
2. Reduce to V_{AT} + 20 kt.

/Cont'd. ...

When descending through 1,500 ft QFE.

3. Select flaps 45°.
4. Reduce to V_{AT} + 10 kt and maintain to the threshold.
5. Start stopwatch.

During final descent:-

6. Check achieved rate of descent on altimeter against stopwatch and, if necessary, adjust.
7. If necessary, correct the rate of descent using the VSI.

On those radar approaches based on the QNH Altimeter Setting Procedure, the Second Pilot's altimeter must remain on QNH until the Captain takes over control.

Fuel Economy Approach

When it is expected that visual conditions will exist during the last 2,000 ft of an approach, then undercarriage and flap selection may be delayed in the interest of fuel economy. As a guide, undercarriage selection may be delayed until 2,000 ft QFE, 26° flap until 1,500 ft QFE, and 45° flap (if required) until 1,000 ft QFE. The aircraft must be fully established in the landing configuration by 800 ft QFE. Speed and attitude control is especially important with later configuration changes, and care must be taken to ensure that the normal speed/configuration relationship is maintained.

On selection of 45° flap, approximately 10,800 HP rpm and 0° nose attitude will be required for a stable approach path to be maintained.

Final Approach

The speeds quoted in this section are those to be flown in normal conditions. Should moderate or severe turbulence be encountered, the approach speed may be increased by 5 kt, but the aim is still to achieve V_{AT} + 10 kt at the threshold.

Manual Approaches, Visual

Fly downwind at 160 kt, Flaps 18° Undercarriage Down. Complete the Approach Drill, turn on to base leg and, when positioned correctly, select Flaps 26° and reduce to V_{AT} + 20 kt.

When correctly positioned, select Flaps 45° and complete the Final Approach Drill. Adjust speed to V_{AT} + 10 kt and maintain to the threshold. In the absence of VASI or any other glide slope guidance, the correct approach path is 3°, normally 650 - 700 ft/ minute rate of descent, with an Approach Aiming point 300 metres from the runway threshold.

If, in the absence of Autothrottle, the speed decays, or the aircraft deviates below the correct approach path, large power increments may be necessary to regain the correct speed and/or the approach path.

26° Flap Approaches

Two engine approach and landings with 26° Flap are approved. 26° Flap should be selected in the normal manner, and the speed then reduced to V_{AT} 26° Flap + 10 kt and maintained to the threshold.

Should an unexpected weather deterioration make the use of 45° Flap preferable, the decision should be taken by 1500 ft QFE: Select 45° Flap, and reduce to V_{AT} 26° Flap and maintain to the threshold.

Note: V_{AT} 26° Flap is approximately equal to V_{AT} 45° Flap + 10 kt.

Limitations are listed under Landing 26° Flap.

Windshear

If Severe Windshear is experienced on the approach, large power changes may be required to maintain the correct glidepath and IAS.

In extreme cases, at low altitudes, full power should be applied and a climb path established to prevent contact with the ground or other obstacles. To achieve this the aircraft may need to be flown at a low IAS approaching the stall warning, (approx V_{AT} - 10 kt) which provides a margin of 6/8 kt above stall recognition. It is important under these conditions to maintain the aircraft configuration, and flap settings must not be changed until the aircraft is safely accelerated through V_{AT} + 10 kt.

OVERSHOOT

Disengage the Autopilot and Autothrottle (if engaged), apply full power and simultaneously rotate the aircraft smoothly into the initial climb attitude (pitch attitude approximately 5° to 10° Up, according to weight and temperature). Do not allow the speed to fall.

Acceleration may be slow at first, but smooth and unhurried rotation is essential if initial loss of speed, due to coarse rotation is to be avoided. When the initial attitude is established, at not less than V_{AT} + 10 kt, select the flaps to 18° and then undercarriage UP. Pitch Attitude must then be increased and must be such as to maintain a positive climb and moderate acceleration. If however, there has been a power loss at this stage, the speed should be maintained at its current value, not less than V_{AT} + 10 kt.

When, normally, a positive climb indication is achieved, maintain the correct attitude, monitoring airspeed and cross-checking with all other flight instruments.

On attaining 180 kt IAS, select flaps UP, reduce to normal climb power, continue accelerating and climbing to 210 kt and the Minimum Safe Altitude or Overshoot Height as shown in the Operations Manual Vol. IVA, where the speed may be maintained at 210 kt for holding or increased to the normal climb speed if diverting. Alternatively, if returning immediately for another approach, on attaining the cleared Altitude/FLT level, the flap could be lowered to 18°, the power adjusted to achieve 170 kt and the Autothrottle re-engaged.

ASYMMETRIC OVERSHOOT)
)
FLAPLESS OVERSHOOT)

See Vol.1 Flight Management, Abnormal Handling Chapter.

LANDING

A correct landing and roll out is ensured by adherence to standard procedures, which provide adequate safety margins.

The ideal approach and landing is one which is made at the correct speed (V_{AT} + 10 kt) and follows an established approach path to cross the landing threshold at approximately 30 feet (wheel height) achieving touchdown some 300 metres from the threshold. Failure to follow prescribed procedures will erode safety margins.

The aircraft must not be landed with a high rate of descent. At 100 ft check the power setting, airspeed, and rate of descent. If the rate of descent is above 1000 ft/min, the approach should be abandoned by taking overshoot action.

The maximum threshold speed is V_{AT} + 15 kt. If the threshold speed exceeds V_{AT} + 15 kt, an overshoot should be carried out, as at higher speeds there is risk of premature nosewheel contact with the runway.

When the approach is continued, on crossing the threshold progressively close the throttles and commence the flare; only a small attitude change is required. Do not prolong the hold off; place the aircraft main wheels on the runway with the nosewheel just off the ground, then extend the lift dumpers and select reverse idle.

Lower the nosewheel gently onto the runway. If reverse thrust is to be used, select normal reverse without delay. In an emergency, Emergency Reverse thrust may be used, and may be selected immediately on touchdown, though care must be taken to avoid heavy nosewheel impact with the runway.

Normal Reverse thrust should be used, except when:-

1. As indicated on the airfield performance summary sheet to alleviate night noise nuisance.
2. The Captain is satisfied that runway conditions are not adverse, that there is no tailwind component and the landing run can be completed without excessive braking.

When the available landing distance is less than 2000 metres, and if the headwind component is less than 10 kt, consider using normal reverse thrust.

See Ops Manual Vol.3 for performance limitations with one or both thrust reversers inoperative.

Landing 26° Flap

The aircraft will assume a slightly more nose up attitude than with 45° Flap, but apart from this the technique is the same as for 45° flap landing.

26° Flap landings may only be carried out in Catetory 1 conditions or better when the landing distance available is 2500 metres or more and:-

1. There is no tailwind component.
2. Runway conditions are not adverse.
3. There are no allowable deficiencies affecting performance e.g. inoperative lift dump, spoiler, reverse thrust or wheelbrake.

The use of 26° flap for approach and landing saves fuel and reduces noise on the approach. Use of harsh braking or normal reverse thrust should be avoided since increased brake and engine wear would negate any cost saving.

CLOUD BREAK

When an instrument approach is to be followed by a visual circuit, select/check flaps 18°, lower the U/C, maintain 18° flap, and fly the visual circuit at 160 kt until established on base leg or turning finals. If necessary inhibit the GPWS GP before reaching 500 ft R.

MANUAL APPROACHES VISUAL

Fly downwind at 170 kt, flaps 18°. A beam touchdown, lower the undercarriage, reducing to 160 kt, and fly for 50 secs. still air. Turn on to base leg and, when positioned correctly, select flaps 26° and reduce to V_{AT} + 20kt.

When correctly positioned turning finals, select flaps 45°. Adjust speed to V_{AT} + 10 kt and maintain to the threshold. The aircraft must be fully established in the landing configuration by 800 ft QFE (600 ft. min.). In the absence of VASI or any other glide slope guidance, the correct approach path is 3°, normally 650-700 ft/minute rate of descent, with an approach aiming point 300 metres from the runway threshold.

If, in the absence of Autothrottle, the speed decays, or the aircraft deviates below the correct approach path, large power increments may be necessary to regain the correct speed and/or the approach path.

ALTERNATIVE APPROACHES

Fuel Economy Approach

When it is expected that visual conditions will exist during the last 1,000 ft of an approach, then undercarriage and flap selection may be delayed in the interest of fuel economy. As a guide, undercarriage may be delayed until 1,500 ft QFE, and the final flap setting made so that the aircraft is fully established in the landing configuration by no later than 800 ft QFE. Speed and attitude control is especially important with late configuration changes, and care must be taken to ensure that the normal speed/configuration relationship is maintained. On selection of 45° flap, approximately 10,800 HP rpm and an attitude of 0° will be required for a stable approach path to be maintained.

26° Flap Approaches

Two engine approaches and landing with 26° flap are approved. 26° flap should be selected in the normal manner, and the speed then reduced to 26° flap V_{AT} + 10 kt and maintained to the threshold.

Two engine 26° flap landings may only be carried out in Cat 1 conditions or better when the landing distance available is 2500m or more and:-

1. There is no tailwind component.
2. Runway conditions are not adverse.
3. There are no allowable deficiencies affecting performance e.g. inoperative lift dump, spoiler, reverse thrust or wheelbrake.

The use of 26° flap for approach and landing saves fuel and reduces noise on the approach. Use of harsh braking or normal reverse thrust should be avoided since increased brake and engine wear would negate any cost saving.

APPROACHING DECISION HEIGHT

Assess steadiness of the approach and aircraft positioning by visual reference or from the displays; if unsatisfactory, disconnect the autopilot, if engaged, and fly the aircraft manually, and either continue the approach by visual reference or continue the instrument approach down to the Cat 1 decision height using the flight director, or overshoot immediately.

If an auto-approach is satisfactory, and visual reference for a continued approach has been established by decision height, the autopilot may remain engaged down to the minimum autopilot disengage height - see FCS and Radio section, Vol 1, Flight Management.

For auto-approaches in bad visibility which require manual take-over because of poor localiser holding, the subsequent judgement of height and control in the pitch axis requires particular care during the later stages of the approach. Therefore, use all aids available, e.g. F/Dir in pitch, VASI's and Approach Lighting. Be particularly careful to note pitch attitude before disengagement and do not allow the nose to drop inadvertently after Autopilot Disengagement.

OVERSHOOT

Disengage the Autopilot and Autothrottle (if engaged), apply full power and simultaneously rotate the aircraft smoothly into the initial climb attitude (pitch attitude approximately 5° to 10° Up, according to weight and temperature). Do not allow the speed to fall.

Acceleration may be slow at first, but smooth and unhurried rotation is essential if initial loss of speed, due to coarse rotation is to be avoided. When the initial attitude is established, at not less than 45° flap V_{AT} + 10 kt / 26° flap V_{AT}, select the flaps to 18° and then undercarriage up. Pitch attitude should be maintained at approximately 10° nose up to achieve positive climb and moderate acceleration. If however, there has been a power loss at this stage, the speed should be maintained at its current value, not less than 45° flap V_{AT} + 10 kt / 26° flap V_{AT}.

When a positive climb indication is achieved, maintain the correct attitude, monitoring airspeed and cross-checking with all other flight instruments.

On attaining V_{FU}, select flaps up, and reduce power to 12,000 HP rpm (or to a value commensurate with the required rate of climb and target altitude), allowing the speed to increase to 210 kt. Thereafter:

1. Maintain 210 kt if holding,

or 2. Increase to the normal climb speed if diverting,

or 3. If returning immediately for another approach, on attaining the cleared altitude or flight level, the flap may be lowered to $8^\circ/18^\circ$, the power adjusted to achieve 170 kt and the Autothrottle re-engaged.

LANDING

A correct landing and roll out is ensured by adherence to standard procedures, which provide adequate safety margins.

The ideal approach and landing is one which is made at the correct speed (V_{AT} + 10 kt) and follows an established approach path to cross the landing threshold at approximately 30 feet (wheel height) achieving touchdown some 300 metres from the threshold. Failure to follow prescribed procedures will erode safety margins.

The aircraft must not be landed with a high rate of descent. At 100 ft check the power setting, airspeed, and rate of descent. If the rate of descent is above 1000 fpm, the approach should be abandoned by taking overshoot action.

The maximum two engine threshold speed is V_{AT} + 15 kt. If the threshold speed exceeds V_{AT} + 15 kt, an overshoot should be carried out, as at higher speeds there is risk of premature nosewheel contact with the runway.

When the approach is continued, on crossing the threshold progressively close the throttles and commence the flare; only a small attitude change is required. Do not prolong the hold off; place the aircraft main wheels on the runway with the nosewheel just off the ground, then extend the lift dumpers and select Reverse Idle.

Lower the nosewheel gently on to the runway. If reverse thrust is to be used, select Normal Reverse without delay. In an emergency, Emergency Reverse thrust may be used, and may be selected immediately on touchdown, though care must be taken to avoid heavy nosewheel impact with the runway.

Reverse Thrust

Normal Reverse thrust should be used when:

a. the landing distance is less than 2,000m;
or b. the landing distance is less than 2,500m and a tailwind exists;
or c. adverse runway conditions exist.
and Reverse idle may be selected when a safe stop is assured.

Otherwise use Reverse Idle Thrust.

If one or more thrust reversers are inoperative, see Performance Manual.

Landing with 26° Flap

The aircraft will assume a slightly more nose up attitude than with 45° flap. There is comparatively little drag and, on a two engine landing, in order to avoid excessive float, the throttles should be closed well before the flare.

Crosswind Landing

Crosswind limitations are given in Check Lists and Drills. The limits shown are maximum permissible crosswind components taking into account any reported gusts.

Normal approach and landing procedures should be used ensuring the aircraft is lined up with the extended centreline of the runway. Just before touchdown, remove drift smoothly with rudder, preventing the upwind wing from lifting by use of aileron.

After landing maintain a small amount of aileron into wind to keep the wings level. In certain conditions reverse thrust may aggravate any tendency to drift if the aircraft "weathercocks". To overcome serious drift it is advisable to revert to forward thrust until the drift has been corrected.

Tailwind Landing

The maximum permissible tailwind and associated landing weight for a runway is listed in the Performance Manual. A landing must not be carried out in tailwind components above the maximum.

Landing in Turbulent Conditions

It is recognised that in turbulent conditions IAS may fluctuate about the intended approach speed. V_{AT} + 10 kt should not be considered as the minimum speed, but should be bracketed as accurately as possible. Should moderate or severe turbulence be encountered the approach speed may be increased by 5kt, but the aim is still to achieve V_{AT} + 10 kt at the threshold. Manual throttle is recommended.

Autolanding

Below 100 ft Radio height, monitor the approach path of the aircraft by visual reference, being immediately prepared to disconnect the autopilot and autothrottle if necessary and either overshoot or carry out a manual landing.

If the autotrim lamp remains on or comes on below 100 ft Radio, the autopilot must be disconnected and a manual landing completed.

If any significant drift is apparent during the autoflare, the Captain should take manual control at the point at which he would wish to eliminate drift.

At touchdown the autopilot and autothrottle will normally disconnect automatically, but the appropriate disconnect buttons should be pressed to inhibit the audio and visual warnings. After touchdown, follow normal landing procedures during the landing run.

Landing in Low Visibility

In low visibility, the landing lamps can produce excessive glare and reduce contrast, thereby reducing the range at which the approach and runway lighting may be seen; in these conditions, extend the landing lamps early, but they should not be switched on until good visual contact has been obtained. If strobe lights are in use the Captain has the discretion to request that they be switched off as soon as full visual contact is established.

Landing in Snow/Slush

See 'Ice and Rain Protection' Vol 1, Flight Management.

DME

1. Select appropriate VOR frequencies.
2. Selector switch to DME. Check against local DME. Use Nav Test switch if no local DME available.
3. Set DME switches to Standby.

CCE

At each station box, check:

1. O/R Norm/Inhibit switch at O/R norm.
2. Test 'A' and 'B' channels.

Cabin Address

1. Make a test call.

Omnitrac

1. Refer FCS and Radio Management, Vol 1 Tech.

FCS PROCEDURES

The following recommended procedures are designed to achieve maximum use of the FCS, but are subject to the Captain's discretion as the situation demands.

PRE-TAKE-OFF SETTING-UP

1.	Compass	As required.
2.	Az master switch	On.
3.	Check remaining FCS Controller switches in-line with engraved markings.	
4.	F/D pitch selector	Full up.
5.	Attitude directors	Erected, fail flags clear. F/Dir index parked. Flags showing.
6.	Drift index	Under fixed lubber, drift shutter closed.
7.	Compass controller	'Comp'. DG flags clear, synchronise.
8.	Coupling switch	'Steer'.
9.	Track pointer head	Runway QDM/outbound Radial.
10.	Setting knob	Out.
11.	Steering index	Runway QDM.
12.	Radio input switches	Both as required.

AFTER TAKE-OFF

1.	F/D switch	On at 500 ft QFE.
2.	Track pointer head	Reqd. track.
3.	Steering index	Reqd. heading.
4.	Radio input switches	As required.
5.	Coupling switch	To 'Track' when required.
6.	Height and speed	Fly aircraft manually, and control on power settings.

Landing Bounce and Recovery

Landing bounce is associated with increasing lift at touchdown and therefore vigorous rearward movement of the control column during the last part of the flare must be avoided. To recover from a bounce put or maintain the control column in the normal flare position and allow the aircraft to settle back on the runway, using additional power to reduce the rate of descent if required. Do not push the stick forward beyond the normal flare position at any time during the bounce. Unless the touchdown speed was considerably in excess of the normal speed and/or runway length is critical, or other adverse circumstances exist, an overshoot should not normally be carried out.

Landing Run/Roll Out

Maintain directional control initially by rudder/rudder fine steering, assisted as necessary by differential braking, and then by nosewheel steering when at taxying speed. Grade brake pressure to suit runway surface conditions and the distance available once the aircraft is firmly established on the ground. In the case of wet runways there is risk of aquaplaning at speeds considerably below the 1-11 minimum aqua-initiation speed of 110 kt. Under such conditions braking should be delayed until after the wheels have spun up. Normal Reverse must be selected without delay. With adverse conditions it may be necessary to use and maintain Emergency Reverse thrust to below 70 kt.

When landing on a runway where the required landing distance is only marginally available, maximum braking must be applied until a safe stop is assured.

The applied brake pressure should normally be checked before cancelling reverse thrust. If it is clear that a safe stop is ensured, select Reverse Idle at 70 kt IAS: Forward Idle should be selected by 60 kt IAS. Before selecting Forward Idle, check that the engine HP rpm have decreased to idle.

A particular fault can cause total loss of braking below a speed of about 30 kts when the anti-skid master switch is On. Therefore the anti-skid system must be switched off at the end of the landing roll.

If it appears that the aircraft will not stop before the end of the runway, use Emergency Reverse thrust. Complete the 'Imminent Overrun Drill'.

Taxying after Landing

Single engine taxy is permitted although manoeuvering area considerations and taxy time availability will determine the use of the procedure. See Flight Management, Engines (b) for limitations.

WINDSHEAR

Severe windshear can compromise the performance margins on take-off and landing to the extent that unplanned ground contact becomes likely (and in extreme cases inevitable).

Shears associated with fronts and inversions can be forecast from met charts. They are generally of a lower order of intensity and normally ineffective below 500 feet above ground level.

Shears associated with thunderstorm activity and microbursts, due to their localised nature, can only be forecast in the most general way and their presence is almost impossible to detect from the flight deck. Thus, if conditions conducive to windshear are forecast, or if line squalls or maturing thunderstorms exist near the airfield, it may well be prudent to delay take-off or approach.

Any encounter with significant windshear should immediately be reported to ATC for the benefit of other aircraft.

Before Take-off

Consider all available weather clues and reports from other aircraft. It may be possible to choose a runway with an increasing headwind direction. If severe windshear is experienced after take-off it may be necessary to maintain a climb profile at the expense of air speed in order to avoid ground contact. APPLY FULL POWER. In extreme cases maintaining an air speed close to the stall warning (approximately V_2 -10 knots) may be necessary, which still provides a margin of 8 to 10 knots above stall recognition speeds.

Before Approach

The same procedures apply as for pre take-off. If severe windshear is nonetheless encountered on the approach, large power changes may be required to maintain the correct glidepath and air speed. In extreme cases, at low altitude, full power should be applied and a climb path established to prevent contact with the ground or other obstacles. To achieve this the aircraft may need to be flown at an air speed approaching the stall warning (approximately V_{AT} - 10 knots) which provides a margin of 6 to 8 knots above stall recognition. It is important under these conditions to maintain the aircraft configuration, and flap settings must not be changed until the aircraft is safely accelerated throughout the equivalent of 18° flap V_2 ie 45° flap V_{AT} +10 knots or 26° flap V_{AT}.

In most cases, windshear of the severity discussed above will have associated with it a degree of turbulence such that the 1-11 auto-pilot will be disconnected either intentionally or by virtue of its inability to cope with the flight path disturbances. Bear in mind that in some met situations and at certain airfields e.g. coastal with little or no turbulence-inducing terrain upwind, windshear can exist with little or no associated turbulence. With no access to ground speed information it would be prudent to assume that noticeably unusual power requirements on approach indicate the presence of windshear and the auto-pilot and/or autothrottle should be disengaged.

TAKE-OFF

Take-Off Run

The scheduled take-off distance assumes that take-off power is applied while the aircraft is held stationary on the brakes. However, the normal procedure of applying power after releasing the brakes adds less than 10m to the take-off distance provided the power is applied without delay. With the same proviso, a rolling start extends the scheduled take-off distance by less than 20m.

During the take-off run too heavy a forward pressure on the control column will add significantly to the drag forces acting on the aircraft.

Abandoned Take-Off from V_1

The Flight Manual distances are based on a technique that results in a fully braked condition being achieved within about 4 seconds of the recognition of an engine failure. When an engine failure occurs before V_1, then of course there will be more runway available for stopping, while the distance needed to stop the aircraft, from the lower speed, will be less. On a critical take-off the change of decision from 'stop' to 'go' at V_1 must be regarded as absolute, and no question of a choice of decision can be entertained.

Rotation and Lift-Off, all Engines Operating

V_R is the target speed for the initiation of rotation, and Flight Manual distances are based on a continuous rotation technique that produces nose-wheel lift-off within one second of V_R, main wheel lift-off within three seconds of V_R, and a height gain of 35 ft in about 200m. The speed reached in this 200m is less than V_2 + 10 kt in the scheduled all-engines take-off, and to ensure clearance of obstances lying under the flight path the speed should not exceed V_2 + 30 kt below 100 ft above the runway. When taking-off with 8° flap, a more nose-up attitude will have to be reached to achieve these times and distances, and therefore a more rapid rotation must be made than in the case of the 18° flap take-off. A one knot error in V_R is worth about 20m, but a one second delay in the nosewheel leaving the runway will add 60m to the take-off distance.

Continued Take-Off after Engine Failure

In the event of an engine failure recognised at V_1, the Flight Manual assumes that the rotation and lift-off technique is modified in such a way as to check the acceleration at V_2 and climb at this speed from a height of 35 ft above the runway. When the engine failure is recognised after V_1, additional margin in the distance to 35 ft appears at the rate of 30m per knot after V_1. If speed is in excess of V_2 at 35 ft after an engine failure at V_1, this is dangerous only in the case of a limited weight take-off with obstacles to be cleared immediately after lift-off. For a thrust loss after V_R, with a speed in excess of V_2, a climb at the achieved speed (V_2 + 20 kt maximum) must be initiated at once.

The Flight Manual assumes that the live engine will be opened to full power within 3 seconds of recognition of engine failure.

Take-Off Performance Margins

Basically, the performance margins are provided by adding 15% extra distance to the measured all-engines distance, by the obstacle clearance margin of 35 ft, and by the rarity of engine failures at precisely V_1. Additionally take-off performance is always based on Minimum Rated Thrust, which in the case of the One-Eleven is about 2.5% below the average level of full throttle thrust that will be used on the live engine in a continued take off after engine failure. However, if at max permitted weight (runway-length-limited) a take-off is abandoned following an engine failure at precisely V_1, the airworthiness standard provides only a 50:50 chance of stopping within the remaining runway when this is not more slippery than a standard wet runway. It is for this reason that the 100 kt limit is set for abandoning a take-off for reasons other than engine failure. From this speed a safe stop is assured in all conditions, even if aquaplanning occurs.

When a wind component is present along the runway, a further performance margin is introduced by taking account of only half of a headwind component, and one-and-a-half times a tailwind component. Nevertheless in the case of light or variable winds, it is good practice to be conservative in the use of reported wind components.

The 15% margin on the normal (all engines) take-off distance typically ensures 200m to 300m of extra runway. In practice variables or imprecisely defined factors such as wind strength, total weight, rolling friction and ASI errors can combine to take up most of this margin on about 1 in 10 occasions. On such occasions when operating at or near the limiting weight for the runway, only a small margin will remain for the effect of variations in the rotation and lift-off technique.

16. Autopilot, Autothrottle —————— Disengage on touchdown.

ILS FRONT BEAM (NO GLIDEPATH) - INITIAL APPROACH & DESCENT AS STANDARD ILS

1. A/P pitch control —— Use to descend to final Outer Marker height (provided not below 1,000 ft QFE) maintaining 160 kt.
2. Height Lock —————— Select if required.
3. Flap —————————— Select 26° when descending through 2,000 ft QFE.
4. Autothrottle ————— Speed switch - Throt.
   Engage switch - Engage, held.
5. Speed ——————————— Reduce to V_{AT} + 20 kt.
6. Autopilot ——————— Disengage before lowering 45° flap or 1000 ft QFE whichever is the higher.
7. Flap —————————— Select 45° at Outer Marker.
8. Speed ——————————— V_{AT} + 10 kt.
9. Coupling switch ——— Leave to 'Track'.
10. Autothrottle ————— Disconnect when crossing the threshold.

ILS BACK BEAM (NO GLIDEPATH) ADF, VOR APPROACH PROCEDURES

ILS Back Beam (No Glidepath) and VOR Approach

1. Nav Receivers 1 and 2— To ILS/VOR Frequency
   If no-glidepath, inhibit GPWS G/P.
2. Radio Input Switches — Port Nav 1, Stbd Nav 2.
3. Track Pointer Heads — Inbound QDM. (VOR) ILS QDM (BACK BEAM ILS).
4. At cleared ALT/FL —— Check Height Locked.
5. Autothrottle ————— Disengage.
6. Speed ——————————— Control with Power.
7. Flaps ——————————— Select 18°.
8. Steering Index ———— Set to achieve outbound QDR when over station.
9. Descent Outbound ——— Control using power, speed lock and Ht acquire/master switches.
10. Steering Index ———— Set for procedure turn after outbound elapsed time.
11. Speed ——————————— When leaving 3,000 ft QFE, lower the undercarriage and reduce to 160 kt.
12. Height lock —————— Select and acquire 1,000 ft QFE.
13. Coupling switch ——— VOR - to Track when on intercept heading.
    B/B ILS - Steer A/C on to back beam, then select Track Tail.
14. Flaps ——————————— Select 26° when descending through 2,000 ft QFE.

/Cont'd. ....

15. Autothrottle ——— Speed switch - Throt, Engage switch - Engage, held.
16. Speed ——— V_{AT} + 20 kt.
17. Auto Pilot ——— Disengage before lowering 45° Flap or 1000 ft QFE whichever is the higher.
18. Flap ——— Select 45° at Final Beacon/Outer Marker.
19. Speed ——— V_{AT} + 10 kt.
20. Steering Index ——— Under fixed lubber, at 1000 ft QFE.
21. Coupling Switch ——— Steering.

N.B. If Cloud Break only, to be followed by visual circuit, maintain 18° flap and 160 kt IAS.

ADF Approach

1. ADF Receivers ——— Required frequency.
2. Radio Input Switches — 'Off'.
3. Track Pointer Head ——— Inbound QDM.
4. At cleared ALT/FL ——— Check Height locked.
5. Speed ——— Control with Power.
6. Flaps ——— Select 18°.
7. Steering Index ——— Set to achieve outbound QDR when over station.
8. Steering Index ——— Set for procedure turn after outbound elapsed time.
9. Speed ——— When leaving 3,000 ft QFE, lower the undercarriage and reduce to 160 kt.
10. Height lock ——— Select and acquire 1,000 ft QFE.
11. Flaps ——— Select 26° approaching Beacon/Outer Marker.
12. Autothrottle ——— Speed switch - Throt, Engage switch - Engage, held.
13. Speed ——— V_{AT} + 20 kt.
14. Autopilot ——— Disengage before lowering 45° flap or 1000 ft QFE whichever is the higher.
15. Flap ——— Select 45° at Final Beacon/Marker.
16. Speed ——— V_{AT} + 10 kt.

N.B. If Cloud Break only, to be followed by visual circuit, maintain 18° flap and 160 kt until visual.

STALLING

Preliminaries

Before any sequence of stall approaches is commenced, the following conditions must be observed:

1. The full Stall Protection System checks shall have been carried out before take-off and all systems found to be fully serviceable.
2. The Aircraft weight shall not exceed the Maximum Landing Weight.
3. The Aircraft CG shall not be further aft than 30 per cent SMC. (This condition is met by the loading instructions for Training Flights, see ATP 872 LOADING 7 & 8).
4. THE BALLAST MUST BE ADEQUATELY STOWED AND SECURED TO PREVENT MOVEMENT DURING FLIGHT.
5. The weather conditions should be smooth and visual, daylight conditions should prevail.
6. The maximum altitude is 15,000 ft on the 1013.2 mbs barometric setting.
7. The minimum altitude is 10,000 ft above the terrain.

It is permissible to lower flaps and undercarriage, in smooth conditions, at up to 18,000 ft in order to trim the aircraft in a descent with flap and undercarriage down, at a speed of 1.4 x Stalling Speed, prior to reducing the speed to the stall. After trimming in this state, the trimmer should not be touched until during recovery. The approach to the stall must not occur above 15,000 ft. (If the stalling speed is high and/or a wing drops violently at the stall, try again at a lower altitude, not below 10,000 ft above terrain).

8. The Autopilot and Autothrottle Master Switches must be selected to 'Kill'.
9. T.T.C./Fuel Dip Switches - 'Arm' both.
10. No 1 Aux Pump - 'On'.
11. Extract Stall Warning Speed from Graphs/Table and bug Trainee's ASI at that speed - 5 kt.
12. Extract Stall Recognition speed from Graphs/Table and bug Training Captain's ASI at that speed.

Cont'd. ...

13. Specify Trim Speed.

14. The Stall Protection systems shall be checked before each approach to a stall:

Heater Fail lamps - all 'Off'
H.P. Reservoir charges - (Minimum 500 psi)
L.P. Gauge Indication - 55 to 59 psi, warn lamp Off
Stick Push Damp Lever - 'In'

Exercises

ONE: Power Off

With the undercarriage down, flaps at 45° and the power off, trim the aircraft in a descent at 1.4 x Stall Recognition Speed. Thereafter leave the trimmer alone until during the recovery. The wings must be kept level. No attempt should be made to overcome the stall recognition operation, should this occur.

The stall should be approached at a deceleration of about 1 kt/sec, as close to 1g as possible. If the speed decrease is stopped for any appreciable time, the exercise should be stopped and the aircraft returned to normal flight before another attempt is made.

Recovery action will be taken by the Trainee at the stall warning operation, or stall warning calculated speed - 5 kt, whichever is first.

To recover, lower the nose until speed increases, then apply full power and rotate smoothly into level flight; an accelerated rotation must be avoided, as this could initiate a dynamic stall. Excessive nose down attitude during the initiated recovery will result in an excessive height loss and may cause the flap limiting speed to be exceeded. To avoid engine malfunctioning do not 'slam' the throttles open when recovering from the stall.

TWO: Power On

With the undercarriage down, flaps at 45° and the power set to 10,800 rpm, trim the aircraft in a descent at the V_{AT} + 10 kt speed. Thereafter leave the trimmer alone until during the recovery. The wings must be level and no attempt should be made to overcome the stall recognition operation, should this occur.

Cont'd....

(b) Crosswind limits are two-thirds of the Captains limit for the existing conditions for both take-off and landing.
(c) Co-pilots may land from an ILS approach carried out to the appropriate Cat 1 decision height. When the base of the reported cloud is less than 500ft above aerodrome elevation, maximum use must be made of the aircraft's automatics.
(d) Co-pilots may land from a non precision approach carried out to the appropriate decision height.

2. Operating Procedures

The approach to Decision Height may be flown with either the Co-pilot or Captain handling the aircraft. It is recommended that if the weather conditions are close to the Cat 1 or non-precision minima, as appropriate, a standard (Co-pilot handling) approach is carried out.

(a) With the Captain handling, a "reverse monitored" approach will take place. The Co-pilot will respond to standard calls whilst seeking visual reference; he will take control at or before Decision Height.
(b) With the Co-pilot handling, standard calls will be made until the Captain is satisfied that adequate visual reference exists for the Co-pilot to carry out the landing. At or before Decision Height the Captain will instruct the Co-pilot to look up and carry out the landing.
(c) The handling pilot will continue to control the aircraft to a safe altitude in the event of an overshoot.

3. Weather Deterioration During Approach

If rapid deterioration is likely the Captain should take this into consideration when deciding whether to authorise the Co-pilot to practise the landing. If an unexpected deterioration occurs, the approach should normally be continued as planned.

4. Command Trainees

The Training Captain conducting command training with the Co-pilot occupying the left-hand seat may, at the Training Captain's discretion, operate to the minima of Section 1 above.

5. New Entry Pilots

Co-pilots with less than 1000 hours or 750 sectors with BA (excluding time on systems stations) may be given take-offs and landings if:

(a) For take-off the visibility is 5 kilometres or more.
(b) Crosswind is less than one-third of the Captains limit for the existing conditions for both take-off and landing.
(c) By 1500ft AAL on the approach visual contact with the runway has been established and can be maintained to touch down.

CREW ASSEMBLY

CAPTAIN	CO-PILOT
Report to Crew Control one hour before STD. At outstations the Captain must ensure that the crew report in sufficient time to complete all duties and checks before STD.	Report to Crew Control and Captain one hour before STD or as directed by Captain.
Check MET and AIS briefing, destination QNH. Brief other crew member. Check aircraft serviceability state. Approve fuel requirements.	Collect necessary flight documents; check all navigation data, MET and AIS info, flight plan, airfield perf data, check/calculate fuel requirement, prepare vital data cards and file ATC flight plan (if necessary).
Approve Flight Plan details, check, as required. Cross check aircraft take-off performance and AOM's.	On the Plog, note the forecast QNH and the minimum diversion fuel (ie: the sum of the diversion and reserve fuel figures for the required alternate).
Confirm ATC flight plan filed. Check all Operational and Administrative notices.	Check all Operational and Administrative notices.

Proceed to aircraft at least 30 min prior to departure time or earlier to achieve a punctual departure.

PRELIMINARY CHECKS

Complete the Exterior Check if required but may be delegated. Liaise with A/C Dispatcher. Inspect the pass. cabin; receive report from SCCM: brief cabin crew as necessary.	Check aircraft library. Exterior Check if required. Complete the Full or Turnround Checks as necessary by 10 minutes before STD.
Check Basic Index and Weight, check a/c documents.	
Estimate take-off weight for gross error check.	
If necessary assist with radio checks.	Report checks complete.

CAPTAIN	CO-PILOT
COMMUNICATION & NAVIGATION EQUIPMENT	
Throughout the operation select RT frequencies as required, maintain communications with ATC.	Monitor communications, log all clearances and frequency changes. Make transponder selections as required. Select RT frequencies if required.
Call for re-selection of nav aids as necessary, monitor frequencies and selection. Identify departure and approach nav aids.	Select, identify and point radio aids as required informing Captain when a new facility is selected, identified or pointing.
PRE-STARTING	
Inspect Tech Log. Check fuel contents. Sign Tech Log. Complete Pre-start Drill. Check ship's papers.	Obtain latest ATIS.
Read out TOW, LDG WT, ZFW, No PAX, TPI.	Record TOW, LDG WT, ZFW, No. PAX, TPI.
Sign ships papers.	
Cross check T/O thrust calculation. Check setting. Agree vital data and set ASI indices.	Calculate whether thrust reduction permissible. Set reference speed booklet, Vital Data card, TPI. Set T/O thrust and ASI indices.
STARTING	
Obtain Start or Start/Push clearances. Give push-back clearance to Engineer if appropriate.	
Initiate Starting Drill by calling "Beacon on, start engines".	Action engine starting sequence.
Monitor engine start sequence. Check LP shaft lamp On. Reset generators at 5000 HP rpm.	
Check HP cocks locked open.	Check HP cocks locked open. Call "Engines stabilised".
Complete remainder of Start Drill.	Action remainder of Start Drills.
FIRE ON START-UP	
Warn ATC. Check with Ground Engineer. State intention. Inform cabin crew of intention.	Execute Engine/APU Fire on Starting Drill.

CAPTAIN	CO-PILOT
TAXYING	
Obtain ATC clearance for taxying.	Record ATC taxy clearance.
Obtain Engineer's visual clearance for taxying.	Confirm Engineer's clearance.
Call for taxying rpm.	Set taxying rpm.
Taxy the aircraft, operate throttles, maintaining look out. Initiate drill when clear of other aircraft. Check rudder.	Call "55" if appropriate.
Monitor drills and action items as required.	Read out Taxy Drills and action appropriate items, including elevator and aileron check.
Receive SCCM's report. Monitor ATC clearance.	Copy down and read back ATC clearances. Select R/T frequencies as required.
TAKE-OFF AND INITIAL CLIMB	
Obtain ATC Take-off clearance and call for Entering Runway Drill. Check approach clear.	Confirm approach clear. Complete the Entering Runway Drill.
Call for Take-Off Drills. Release brakes as power is applied. Start stopwatch as the aircraft rolls.	Apply Take-off power check and call "Take-off Power" when achieved. Start stopwatch as aircraft rolls. Cross-check speed on both ASIs.
Control the aircraft, rotate at V_R.	Monitor engine instruments. Call "100 kt", "V_1" and "V_R". Move hand to base of throttles at V_1. Engine failure above V_1 - open both throttles fully.

If it becomes necessary to abandon the take-off: the operative call is "STOP" - from either crew member. The Monitoring Pilot will call "Stop" if he observes any malfunction before reaching 100 kt, or if either thrust gauge reading falls below 80% before V_1. The Captain will call "Stop" if he observes any emergency which he considers necessitates an abandoned take-off.

1. Apply full, or required, brake pressure to ensure a stop in the available distance. 2. Keep aircraft straight on runway. 3. When aircraft has slowed to taxy speed and if fire suspected, turn before stopping so that fire is downwind of fuselage.	1. Close thottles. 2. Select lift dumpers Out. 3. Apply EMERGENCY Reverse thrust on operative engine(s). 4. Call out achieved brake pressures.

CAPTAIN	CO-PILOT
4. When stopped:- Regain/Keep control of aircraft. Apply parking brake. Call for appropriate emergency drill. Assess situation. If required call for Imminent Over-run/Pre Evacuation Drill.	5. Action appropriate drill ordered by Captain. Action Imminent Over-run/Pre Evacuation Drill if necessary.

If a stop is not ensured before the aircraft reaches the end of the runway and the aircraft is approaching rough ground or obstacles:-

Take control of aircraft Call for Imminent Over-run/Pre Evacuation Drill.	Execute Imminent Over-run/Pre Evacuation Drill as requested and deal with the original emergency after the aircraft has stopped.

CONTINUED TAKE-OFF

When a positive climb is established call "Undercarriage up"	Check and call "Positive climb. Select and call "Undercarriage up", check red lamp on. Push in fire bell isolation lamp. Switch off and retract landing lamps. From V_R to 500 ft monitor height, attitude, airspeed. Call attention to errors with 'Height', 'Attitude', or 'Speed' as appropriate.

NOISE ABATEMENT

At 500 ft check V_{FU} (top bug) has been achieved and call "Flaps zero".	Check that V_{FU} (top bug) has been achieved and select flaps to zero, set noise abatement power. Simultaneously call "Speed checked, flaps zero, power".
Speed below V_{FU} at 500ft (18° flap T/O): Check speed within 10kts of V_{FU}. Call "Flaps 8°". Check V_{FU} is achieved. Call "Flaps zero".	Check speed within 10kts of V_{FU}. Select 8° flap. Call "Flaps 8°". Check V_{FU} is achieved. Select flaps zero, set noise abatement power. Simultaneously call "Speed checked, flaps zero, power".
Call "Flight Director" if required.	Engage Flight Director if ordered. Select start/relights off.
Approaching 1500 ft call "Air changeover".	Select air changeover and airframe anticing if required.
At the end of the noise abatement climb (usually 4000 ft) re-check flaps zero and call "Flaps are zero. Climb power and Climb Drills".	Re-check flaps zero, set climb power, check completion of After Take-off Drill, and execute Climb Drills.

CAPTAIN	CO-PILOT
CLIMB	
Engage autopilot as soon as practicable. Confirm "1,000 ft to go" when approaching cleared FL/altitude.	Call "1,000 ft to go" when approaching cleared FL/altitude.
After the completion of the Climb Drills, ask "Compass set for take-over?"	Confirm "Compass set".
Call "You have control".	Reselect compass switch and say "I have control".
Manage and monitor the flight.	Ensure compliance with ATC clearances.
Call "1,000 ft to go" when approaching cleared FL/altitude.	Confirm "1,000 ft to go" when approaching cleared FL/altitude.
CRUISE	
Monitor power settings and speeds. Manage and monitor the flight. If autopilot is U/S, select, identify and point radio aids.	Control and navigate aircraft on automatics. If the autopilot is U/S, fly aircraft, and identify aids.
Specify weather information required.	Obtain weather information as requested. Pass messages on Company frequencies.
Monitor fuel selections. Brief for fuel check as appropriate.	Carry out fuel management drills. Carry out fuel check.
PRE-DESCENT	
Set standby altimeter to destination forecast QNH.	Obtain surface conditions wind components and RVRs as required.
Brief for the approach: airfield, lighting min safe altitude, approach pattern, profile, overshoot, radio aids. Brief for landing: anticing, relights landing distance requirements, final flap setting, reverse thrust.	Cross-check briefing, determine descent point.
Establish V_{AT}, set ASI indices and cross-check.	Establish V_{AT}, set ASI indices and cross-check.
Establish Decision Heights and Limiting RVR or Visibility. Set servo altimeter bug and radio altimeter bug. (if applicable). If necessary, check all requirements for Cat 2 or 3 and reversion to Cat 1 including mid-point RVR.	Check and bug servo and radio (if applicable) decision height.

PRE-STARTING

CAPTAIN	SECOND PILOT
Inspect Tech Log.	Obtain latest ATIS.
Check fuel contents.	
Sign Tech Log.	
Identify Radio/Nav aids selected.	Select and identify Radio/Nav aids as required.
Complete Capt's Check.	Confirm completion of items of Capt's Check.
Check ship's papers.	
Read out TOW, LDG WT, ZFW, No.PAX Sign ship's papers.	Record TOW, LDG WT, ZFW, No. PAX Set reference speed booklet, Vital Data card.

STARTING

CAPTAIN	SECOND PILOT
Obtain Start or Start/Push clearances.	Select R/T frequencies as required.
Give push-back clearance to Engineer if appropriate.	
Read out spoken items of Starting drill.	Carry out Drills and Engine Starting sequence as requested
Monitor engine start sequence.	Record max T.G.T.'s.
	Check HP cocks locked open. Call "Engines stabilised".
Cross check T/O thrust calculation, check setting.	Calculate thrust reduction, if permissible. Reset T/O thrust index.
Agree vital data, bug V_1, V_2 on ASI indices and cross-check.	Bug V_1, V_2 on ASI indices.

FIRE ON START-UP

CAPTAIN	SECOND PILOT
Warn ATC. Check with Ground Engineer. State intention. Inform Cabin Staff of intention.	Execute Engine/APU Fire On Starting drill.

PRE-TAXY

CAPTAIN	SECOND PILOT
Action items of Pre-Taxy Drills as requested.	Read out Pre-Taxy Drills, action items as applicable, and cross-check completion of other items.
Obtain ATC clearance for push-back.	
Give push-back clearance and wheels rolling time to Engineer.	

TAXYING

CAPTAIN	SECOND PILOT
Obtain ATC clearance for taxying.	Record ATC taxy clearance.
Obtain Engineer's visual clearance for taxying.	Confirm Engineer's clearances.
Call for taxying rpm.	Set taxying rpm.
Taxy the aircraft, operate throttles, maintain look out and communications. Initiate drill, when clear of other aircraft.	Call "55" if appropriate.
Monitor drills and ATC clearance.	Read out Taxy Drills as appropriate and action items.
Operate throttles on reverse thrust check. Cross check achieved flap setting. Check Rudder Receive CC i/c's report.	Cross check reverse thrust check. Copy down and read back ATC clearances. Select R/T frequencies as required. Call Taxy Drills complete.

APPROACHING DECISION HEIGHT

CAPTAIN	CO-PILOT
Continue to monitor aircraft handling whilst seeking visual reference.	At 100 ft above - prepare for overshoot at decision height. Call "100 above".

At a descent rate of 600 ft/min, the DH will be reached in 10 secs after the "100 above" call.

AT DECISION HEIGHT

With adequate visual reference call "Land", take over control and continue the approach - otherwise call "overshoot".	Call "Decide". If "overshoot" called or no reply made (applies to all categories of approach inc Cat 3) initiate overshoot.

CONTINUED APPROACH

Observe the minimum autopilot disconnect height.	Monitor displays, autothrottle/ autopilot performance. Check ROD less than 1000 ft/ min. Inform Handling Pilot of discrepancies.

PRIME LAND APPROACH

At 100 ft ARTE:	Check land annunciator changes to ATT. Check ROD, inform handling pilot if exceeding 1000 ft/min. Check power, advise if abnormal.
At 50 ft ARTE (manual landing only): Disengage autopilot and continue with normal manual landing, disconnecting the autothrottle when crossing the threshold.	Call "Land Manual". Check autopilot MI displays OFF.
At 50 ft ARTE (Autoland only):	
Monitor approach accuracy by visual reference.	Check land annunciator changes to Blank, call "Flare". Call "Land manual" if incorrect indications on land annunciator or on observing any other malfunction of autopilot or autothrottle.
Press autopilot and autothrottle disconnect buttons at touchdown or if "Land manual" call made.	Check autopilot MI displays OFF.

OVERSHOOT

Once initiated, an overshoot must be completed by the handling pilot.

CAPTAIN	CO-PILOT
Check autopilot disengaged, MI displays Off, and full power applied. Check satisfactory transition to the climb and call "positive climb". Select and Call "Flaps 18°, undercarriage up, FCS to Steer".	Call "Overshooting". Disconnect autopilot/autothrottle and apply full power. Rotate aircraft into the climb attitude and complete the overshoot calling out the memory items of the Overshoot Drill.
Complete the Overshoot Drill. Adjust power as required. Monitor correct execution of the overshoot procedure.	Continue to handle the aircraft. Monitor power selections. Engage autopilot as soon as practicable.

LANDING

Disconnect the Autothrottle when crossing the runway threshold (manual landing).	Check ROD and inform handling pilot if over 1000 ft/min. Check and call rpm settings.
At touchdown call "Dump".	Select lift dumpers Out.
Keep aircraft straight with rudder fine steering.	Select Reverse Idle then reverse thrust unless otherwise briefed.
Apply brakes as necessary. Call "Brakes".	Check and call initial brake pressures.
At 70 kt call "Reverse Idle", followed by "Forward Idle" if reverse thrust no longer required.	Call "70 kt". Select Reverse Idle, then Forward Idle by 60 kt. If engine rpm falls below 5,500 close the HP cock immediately.
At the end of the landing roll, at taxying speed, with no brake pressure applied, call "Anti-skid off".	Select anti-skid off.

If over-run likely and the Co-pilot is handling, the Captain will take control

Call "Imminent Over-run Drill" if necessary.	Execute Imminent Over-run Drill.

CAPTAIN	SECOND PILOT
When accelerating through 180 kt, call "flaps zero".	Check speed increasing through 180 kt, select and call "flaps zero".
Call "After 3,000ft drills".	Check completion of the After Take-off Drill from the Drills cards.
Check flaps zero.	Complete the After 3,000 ft drill.
Engage autopilot as soon as practicable. Confirm "1,000 ft to go" whan approaching cleared FL/altitude.	Call "1,000 ft to go" when approaching cleared FL/altitude.

FLIGHT DIRECTOR

The handling pilot will adjust the FD pitch selector to correspond with steady flight conditions. The monitoring pilot will make FD selections as requested.

If there are any doubts about the validity of the FD presentation, the FD must be selected off.

CLIMB

CAPTAIN	SECOND PILOT
After the completion of the 3,000 ft Drills, ask "Compass set for take-over?"	Confirm "Compass set".
Call "You have control".	Reselect Compass Switch and say "I have control".
Maintain communications with ATC. Select R/T frequencies as required, normally using VHF 1.	Ensure compliance with ATC clearances. Select Radio Aids as required, informing Capt., of changes.
Manage and monitor the flight. Call "1000 ft to go" when approaching cleared FL/altitude.	Confirm '1000 ft to go' when approaching cleared FL/altitude.
	Extract and set cruise thrust index (FL200 and above).

CRUISE

CAPTAIN	SECOND PILOT
Monitor power settings and speeds. Manage and monitor the flight.	Control aircraft on automatics, and navigate, selecting and identify navigation aids as required. Advise whenever a new facility is selected, identified or pointing.
If autopilot is U/S, select, identify and point radio aids.	If the autopilot is U/S, fly the aircraft, and identify aids.

CAPTAIN	SECOND PILOT
Maintain communication with ATC. Log all clearances and frequency changes. Select R/T frequencies as required. Call for re-selection of nav aids as necessary, monitor frequencies and selections.	Monitor communications, log all clearances and frequency changes. Make transponder selections as required.
Specify weather information required.	Obtain weather information as requested.
	Pass messages on Company frequencies.
Monitor fuel selections.	Carry out Fuel Management Drills.
Brief for fuel check as appropriate.	Carry out fuel check. Check fuel as per Nav log. Complete MEDM form.
Initiate information to passengers by Cabin Address.	

PRE-DESCENT

CAPTAIN	SECOND PILOT
Set standby altimeter to destination forecast QNH.	Obtain surface conditions wind components RVRs as required.
Brief for the approach:- airfield, min safe altitude, approach pattern, profile, and overshoot from Vol IVA, radio aids.	Cross check briefing, determine descent point.
Brief for landing:- anticing, relights, landing distance requirements, final flap setting, reverse thrust.	
Establish V_{AT}, set ASI indices and cross check.	Establish V_{AT}, set ASI indices and cross check.
Establish Decision Heights and Limiting RVR or Visibility. Set servo altimeter bug and radio altimeter bug,	Check and bug servo and radio (if applicable) decision height.
If necessary, check all requirements for Cat 2 and reversion to Cat 1 including mid-point RVR.	
Complete Pre-Descent drill.	

FULL CHECKS

FLIGHT DECK PRELIMINARIES

1.	Battery/Essential AC	Check.
	Air Conditioning	Off. (Master valves closed, air delivery and X-feed closed, cooling fan switch to isolate.) This is to prevent air conditioning overheat when power is removed from the cooling fan.
	Battery switch	On.
	APU/GPU	Trip.
	DC fail lamp	On (showing that the main DC busbar is isolated from the essential DC busbar).
	Battery lamp	Out (test) (showing that the battery and essential DC busbars are connected).
	Essential AC	115v/400 cps. This shows that the static inverter system is serviceable.
	Battery voltage	Press battery volts button to check a minimum 23 volts under the load of the inverter.
	Normal electrics	Restore if GPU available or APU running.
	Air conditioning	Restore if APU running (see below).
2.	Fire control handles	In.
3.	Firebottle discharge indicators	Amber.
4.	APU Start, if GPU unavailable or air conditioning required.	
	Fire switch	Manual.
	Fire handle	In.
	Fire warning	Test.
	Oil LP lamp	Test.
	Check clear for start up.	
	Start master	APU.
	Control switch	On, fuel valve - open.
	Start button	Push (2 seconds).
	Check EGT rising, indicator START, blank then RUN.	
	Oil LP lamp	Out.
	EGT	Within limit 760°C during start, 570°C when stabilised.
	Start Master	Off, within one minute.
	Fire switch	Auto.
	Generator	Check on line (APU generator fail lamp out, 115v/400cps).
	Air conditioning may be introduced one minute after APU start.	

Cooling fan switch Normal.
Air delivery valve Open.
Air crossfeed valve Open.
Master valves APU.
Temperature controls Auto.

5. Exterior lights On.
Ice insp, nav, beacon, wheelwell, turn-off.)

6. Nosewheel visual indication Green, full disc.
(Requires wheelwell light on.)

7. Aircraft documents Check.
The document stowages should contain:
Certificate of Registration.
Certificate of Airworthiness.
Weight and CG balance extract.
Radio installation licence.
Radio installation approval.

8. Pressurisation amplifier lamp Out.
If illuminated the adjacent Ground Test/Flight switch has been left at 'Ground' and the diff pressure will rise rapidly when the last a/c door or window is closed.

9. Power failure lamp Test.
This will be On if GPU is powering electrical system, Out if APU is on line.

10. Cb's Check set.

11. Aircraft library Check.
The aircraft library consists of:
Back-up manuals' valise. The valise contains a Topographical Map. The valise number should agree with the number given on the DISC ADD entry.
Vol 1 Technical.
FCO's.
FCN's and FODN's.
Cabin Crew Manual.
Load and Balance Manual.
Aerad Supplement.
Spare forms wallet.
IATA Handbook of Restricted Articles.
Fuse and cb location card.
Charts Wallet.
Vol 1 Flight Management.
Check Lists and Drills (2 sets).

12. Spare headset Stowed.

13. Cooling fan switch Normal, shutters auto.

14	Emergency equipment	Check
	The flight deck emergency equipment consists of: 3 crew lifejackets. 2 smoke masks. 1 pair of smoke goggles. 1 310 litre oxygen cylinder. Fixed oxygen system. 1 BCF extinguisher. 2 escape ropes. 1 Scott's smoke hood and asbestos gloves. 1 fireaxe.	
15.	Standby steering	Off, test lamp.
	If lamp is illuminated, the standby steering accumulator pressure has fallen below 2000 psi. Do not pressurise No. 1 system without engineering clearance.	
16.	Radars, radios, a/pilot, a/throttle	Standby, on.
	Radars	Standby, power on.
	2 VHFs	On.
	2 NAVs	DME.
	2 ADFs	ADF
	Transponder	Standby.
	Autopilot master	On.
	Autothrottle master	On.
17.	Undercarriage selector	Down, 6 greens.
	Check 6 green filaments.	
18.	Free fall lever	Down.
19.	Pitot isolate switch	Normal.
20.	Flight systems gyro switch	On.

PORT INSTRUMENT PANEL

1.	Warning lamps	Test.
2.	Marker lamps	Test, select Lo.
3.	Stopwatch	Check.
	Check fully wound and functioning.	
4.	Radio altimeter	Test.
	Press test button and check that both instruments indicate approx 30' with fail flags in view. Test the 'Below DH' warning lamp.	
5.	Flight instruments	Check.
	Check instrument condition and serviceability (where appropriate), compass synchronised - check against E2B.	
6.	Static selectors	Normal.

CENTRE INSTRUMENT PANEL

1.	Warning lamps While checking the panel, test the following lamps: reverser unlocked, oil LP, firebell isolation, flap shaft fail, mach trim, auto trim and cabin altitude.	Test.
2.	TAT gauge	Check.
3.	Fuel totalisers	Zero.
4.	Engine overheat Press each lamp to test the LP cooling air overheat circuit and operate switch to reset. Hold Zone 2 test switch to 'test' and check both lamps. This tests the integrity of the Zone 2 firewires.	Test-reset.
5.	Engine instruments	Check.
6.	Vibration indicators When test buttons are pushed, the indicators should show between 6 and 8 relative amplitude.	Test.
7.	Anti-skid With the system selected on, push the switch up, then release. Inner REL indicators should illuminate briefly. Push test switch down then release. Outer REL indicators should illuminate briefly. Switch system Off.	On-Test-Off.
8.	Engine fire warnings Both filaments in the associated fire control handle should illuminate and the fire bell should ring. This tests the integrity of the Zone 1 firewire.	Test.
9.	Undercarriage horn	Test.
10.	Cabin selector Planned cruise level above FL180: Set 1013 on millibar scale, and the cabin altitude corresponding to the cruise level under the pointer. Planned cruise level FL180 or below: Set QNH on millibar scale, and the airfield elevation +500 ft under the pointer.	Set.

STARBOARD INSTRUMENT PANEL

1.	Warning lamps	Test.
2.	Marker lamps	Test, select Lo.
3.	Flight instruments As port panel	Check.
4.	Clock/stopwatch Check fully wound and functioning. Check correct time on clock.	Check.
5.	Static selectors	Normal.

STARBOARD CONSOLE

1.	GPWS "Whoop Whoop. Pull up. Glideslope".	Test.
2.	Stall rec pressures	HP 500 min, LP green.
3.	Oxygen system	Check.
	Contents	Minimum 3/4 full.
	Oxygen Supply valve	Fully open, pressure in "Normal" green sector.
	Pax oxygen valve	Fully off.

LANDING

CAPTAIN	SECOND PILOT
Disconnect the Autothrottle when crossing the runway threshold (manual landing). At touchdown call "Dump". Keep aircraft straight with rudder fine steering. Apply brakes as necessary. Call "Brakes".	Check ROD and inform handling pilot if over 1000 ft/min. Check and call rpm settings. Select Lift Dumpers Out. Select Reverse Idle then reverse thrust unless otherwise briefed. Check and call initial brake pressures.
At 70 kt call "Reverse Idle", followed by "Forward Idle" if reverse thrust no longer required.	Call "70 kt". Select Reverse Idle, then forward Idle by 60 kt. If engine rpm falls below 5,500 close the HP cock immediately.

If over-run likely and the co-pilot is handling, the Captain will take control.

Call "Imminent Overrun Drill" if necessary.	Standby to execute Imminent Overrun Drill.

AFTER LANDING

Taxy aircraft and maintain look out. Call for After Landing Drill.	Complete the After Landing Drills. Monitor brake accumulator pressures during taxying.
Call for Shutdown for Turnround Drill. Call for Full Shutdown Additional Items Drill if applicable. Apply Handbrake, release when chocks in place. Complete and sign the Technical Log.	Complete the Shutdown for Turnround Drill. Full Shutdown Additional Items Drill if applicable.

16. Radios Check

Markers

Select Lo.

Comms

Test Comms transmitter/receiver on local frequency designated for testing.

Navs

Identify local ILS on NAV receivers and check displays on flight compasses. Repeat on local VOR. Set RMI input switches to VOR and check bearing pointers. If there are no VOR's within range use NAV Test switch. The technique is described in Vol 1, Technical, FCS and Radio.

ADF's

1. Select function switch of each ADF Controller to ADF.
2. Sharp/Broad switch to Sharp.
3. Identify local beacon on ADF receivers. Set RMI input switches to ADF and check bearing on pointers.

Transponder

1. Function switch - S/B.
2. AR switch - ON.
3. Code 00 00.
4. After one minute from switch-on, select mode A and press Test button. If system serviceable, monitor lamp lights for 10-15 secs.
5. Test other system.
6. Function switch - S/B.

DME

1. Select an appropriate local VOR or ILS frequency.
2. Set selector switch to DME. Check DME range. Use Nav Test switch if there is no local DME available.

CCE

At each station box, check:

1. O/R Norm/Inhibit switch at O/R Norm.
2. Test 'A' and 'B' channels.

Cabin Address

Make a test call.

CVR

1. Open an HP Cock.
2. Press Test button for 5 seconds,the meter should read in the "GOOD" sector whilst the button is depressed if all four channels are serviceable.

PRE-START

1.	3 locks	Stowed.
2.	Flight recorder	Date, flt no.
	Select date, month and flight number. Press 'Insert Ident'.	
3.	BRIEFING--Emergencies, emergency turn, Ha. Runway state, precipitation precautions. Initial terrain. SID. Transition altitude. Noise abatement. Radio aids.	
4.	Altimeters	Set and cross-check.
	See Altimeter Setting and Checking.	
5.	FCS	Set for take-off.
	See FCS Procedures.	
6.	Handbrake	On, 2800 psi, brake temps.
7.	APU	Started, gen and air on line.
	See Full Checks.	
8.	Dump valve	Shut, showing open.
	Push dump valve control down, check fully anticlockwise and indicator shows open.	
9.	Tech Log	Signed.
10.	Ships papers	Signed.
11.	Take-off thrust	Set.
12.	V_1, V_R, V_2, V_{FU}, V_{MO} TPI	Extract, set and cross-check.
13.	Flight recorder	Take-off weight.
	Set the first three numbers of the take-off weight in the first three spaces of date/month. Press 'Insert Ident'.	
14.	Doors lamps (push and start)	All out.
	(start only)	Rear cargo and ventral out.

ENGINEER/ATC - CLEAR TO START/PUSH

START

1. Capt to Co-pilot	Beacon on, start engines.
Beacon	On.
Hydraulic pumps	Off.
Master valves	Closed.
Isolation valves	1 closed, 2 open.
Stbd booster pumps	On.
Engine generators	Trip.
Frequency/Volt selector	Generator 2.
Start master switch	Start.
Engine 2 start/relight switch	Start (2 secs).
Ignitor lamps	Check on.
Master warning lamps	Arm
LP shaft lamp	On
HP cock lever	Start at 1500 to 1850 HP rpm.
HP cock lever	Open when TGT passes 500°C (or stabilises) or at 5000 HP rpm.
No.2 engine generator	Reset at 5000 HP rpm.
No.2 hydraulic EDP	On.
Engine instruments	Check, warning lamps out.
No.1 isolation valve	Open.
Air crossfeed valve	Closed.
Port booster pumps	On.
Frequency/Volt selector	Check readings, select Essential.
Engine 1 start/relight switch	Start (2 secs).
Ignitor lamps	Check on.
LP shaft lamp	On.
HP cock lever	Start at 1500 to 1850 HP rpm.
HP cock lever	Open, when TGT passes 500°C (or stabilises) or at 5000 HP rpm.
No.1 engine generator	Reset at 5000 HP rpm.
Engine instruments	Check, warning lamps out.
Start master switch	Off/engines stabilised.

Note: The HP cocks may only be returned to the start position once the start cycle has been cancelled, and the start lamps extinguished. This action may be used to overcome a hung start (i.e. when the engine fails to accelerate to idle rpm).

- engines stabilised -

2.	Start master	Off.
3.	Air conditioning	Set.
	Air crossfeed valve	Open.
	Master valve switches	APU.
	Temperature controls	Auto.
4.	Safety valve	Normal.
5.	Engine antice	As required.
	OAT below +10°C and	a) visibility below 1000m,
	or	b) runway is wet,
	or	c) icing conditions present.
6.	Electrics panel	Check.
	Check warning lamps out, kVA, TRU and battery readings normal.	
7.	Pitot heaters	On.
	Heater fail lamps (4)	On.
	Pitot heater switches (5)	On.
	Pitot ammeters (5)	Check.
	Heater fail lamps (4)	Out.
8.	Doors	Closed, lamps out.
	Check all 8 warning lamps by pressing the test button.	
9.	Windows	Pin and line.
10.	Flight recorder	Start, check on.
11.	Standby horizon	Erect, flag clear.
	Do not press fast erect button within 30 seconds of power being supplied (i.e. opening of HP cock) or for longer than 1 minute.	
12.	Power fail warning lamp	Out.

ENGINEER'S CLEARANCE.

Ensure that the engineer is clear of the a/c before continuing.

13.	Hydraulics	EDPs on, No.1 aux on.
	No.2 EDP	Check on, check pressure, lamp out.
	No.1 EDP	On, check pressure, lamp out.
	No.1 aux pump	On, lamp out.
14.	All warning lamps	Out.
15.	Footbrakes	Check pressures.
	Apply footbrakes at both pilot positions and check pressures indicated on the footbrake pressure gauge.	

ENGINEER/ATC - CLEAR TO TAXI

TAXYING

1.	Speedbrake	Check.
	Speedbrake lever	Collar up, fully aft.
	Lift dump MI's	'OUT'.
	Speedbrake lever	Fully forward, MI's blank.
2.	Flaps	Select.
3.	Tailplane and trimmers	3 up and zero.
	Rudder and aileron trims	Zero.
	Elevator trim tab	Zero.
4.	Flight instruments	Check.
	A check during a turn in one direction only is required, e.g.: During a right turn: 'Turning right, skidding left (both turn and slip flags clear), three horizons remaining steady, compasses (5) increasing through (heading) degrees, steady and rational bearings on the RMI's.' When the turn is complete: 'Compasses steady on (heading) degrees.'	
5.	Firebell isolation lamp	Pull.
	Check lamp illuminated.	
6.	Reverse thrust	Check (after full checks).
	This drill may be omitted if reverse thrust has been satisfactory on the previous flight that day.	
	Reverse throttle levers	Idle.
	Reverser unlocked lamps	On.
	Reverse throttle levers	Forward, lamps out.
7.	Flying controls	Check.
	Rudder, ailerons and elevator	Check operation unrestricted.
8.	Configuration	Handling pilot check.
	The handling pilot will check the required flap setting, flap lever position, achieved flap setting, the tailplane is set 3 divisions nose-up and elevator trim is zero.	
9.	Stewards report	Received.
10.	ATC clearance	Received.

ENTERING RUNWAY

11.	Vital data/anticing.	Check still applicable.
	Re-assess surface conditions for take-off and if necessary, adjust vital data	
12.	Cabin crew	Signal.
13.	Anti-skid	On, check brake temps.
	If the brake temperatures are above 200°C refer to Hydraulics, page (d), Vol 1 Flight Management.	
14.	Transponder	As required.

From Memory

TAKE-OFF DRILLS

1.	Start/relight switches	As required.
2.	Brakes	Off, pressures zero.
3.	Power	Check temperatures, pressures, rpm.
4.	Stopwatches	Start.
5.	Call	'Take-off power, 100 kt, V_1, V_R.'

AFTER TAKE-OFF

1.	Undercarriage	Up, lamps out.
	Check/select lamps to Bright.	
2.	Firebell isolation lamp	In.
3.	Landing lamps	Retract. off.
4.	Start/relights	Off.
5.	Air conditioning	Set.
	No.2 master valve	Open.
	Pause 2-3 seconds	
	No.1 master valve	Open.
	Pause 2-3 seconds	
	Air cross-feed valve	Closed.
	Air delivery valve	Closed.
6.	Anticing	As required.
	If required:	
	Wing antice switches	On.
	Tail antice switches	On.
7.	Flaps	Zero.
8.	Cabin notices	As required.
9.	Altimeters	As required.

CLIMB

1.	Pressurisation	Check.
2.	APU	Off unless essential.
3.	No.1 aux pump	Off.
4.	Fuel transfer	As required.
	If there is centre tank fuel:	
	Transfer pump switches	On, lamp out.
	Transfer cock switches	On.
	Transfer cock MI's	In-line.
5.	Speedbrake	Collar down.
6.	TTC switches	Arm both.
7.	Altimeters	1013 when cleared to FL.

DESCENT

1.	Vital data/briefing	Confirmed.
	Briefing will have been completed before descent.	
	ASI bugs	V_{AT}, $V_{AT}+10$, V_{FU}.
	Servo altimeter bugs	Decision height.
	Radio altimeter bugs	Decision height (if applicable).
2.	Standby altimeter	Destination QNH.
3.	Cabin selector	Set.
	Set QNH on millibar scale, and the airfield elevation +500 ft under the pointer.	
4.	Fuel contents	Check, transfer complete.
	Compare fuel contents with minimum diversion fuel requirement.	
	Booster pumps	All on.
	Even if transfer not complete, it must be terminated before landing	
	Crossfeed cock	Shut.
	Transfer pumps	Off.
	Transfer cocks	Closed.
5.	Prime land approach:	
	This drill is required only when carrying out a Prime Land approach.	
	Radio altimeter	Test.
	See Full Checks, port instrument panel.	
	Autoflare computer	Test.
	Press test button and check blank/stripes/blank on M.I.	
	IFM	Reset.

APPROACH

1.	Altimeters	QNH and cross-check.
2.	Speedbrake	Collar up.
3.	TTC switches	TTC only.
4.	APU	As required (25°/2200'/circ min)
	Start the APU if:	
	Surface temperature	Above 25°C.
	or, Airfield elevation	Above 2200 ft.
	or, Cloudbase	Approaches circling minima.
5.	No.1 aux pump	On.
6.	Cabin notices	On.
7.	FCS	Set for approach.
	See FCS Procedures.	
8.	Altimeters	QFE and cross-check.

LANDING

1.	Undercarriage	Down, 3 greens.
	Select 'Bright' to confirm 3 greens and no red lamp. Select 'Dim' if necessary.	
2.	Brake pressures	Zero, accs 2800, anti-skid On.
3.	Radar	Standby.
4.	Anticing, relights	Set for landing.
	At 1500 ft:	
	Wing and tail anticing	Off.
	Engine anticing	As required.
	OAT below +10°C and	a) visibility below 1000m,
	or	b) runway is wet,
	or	c) icing conditions present.
	Start/relight switches	As required (runway wet).
5.	Air conditioning	Set for landing.
	If APU is running:	
	Air delivery valve	Open.
	Air crossfeed valve	Open.
	No.1 master valve	APU.
	No.2 master valve	APU.
	To guarantee single engine overshoot performance:	
	If APU is unserviceable and	
	Surface temperature	Above 25°C.
	or, Airfield elevation	Above 2200 ft.
	Air delivery valve	Closed.
	Air crossfeed valve	Closed.
	No.1 master valve	APU.
	No.2 master valve	APU.
6.	Cabin crew	Report, signal.
7.	Flaps	Final setting.

(From memory)

OVERSHOOT

Full power	Set.
Attitude and speed	Establish and check.
Flaps	Select 18°.
Undercarriage	Select up.
FCS	Select steer.
Altimeters	As required.

AFTER OVERSHOOT

1.	Undercarriage	Up, lamps out.
2.	Landing lamps	Retract, off.
3.	Altimeters	As required.
4.	Start/relight switches	Off.
5.	Air conditioning	Set.
	As after take-off.	
6.	Anticing	As required.
	As after take-off.	
7.	Flaps	Zero.
8.	Cabin notices	As required.

DIVERTING: Continue with Climb drills.
FURTHER APPROACH: Re-check vital data/briefing/fuel and continue with Approach drills.

AFTER LANDING

1.	Anti-skid	Off.
2.	Lift dump and flaps	In and up.
3.	APU	Start.
	See full checks.	
4.	Pitot heaters	Off.
	Check four heater lamps illuminate.	
5.	Start/relight switches	Off.
6.	Safety valve and DV window	Open.
7.	Tailplane	3 divisions nose-up, check ind.
8.	Az master	Off.
9.	Transponder	Standby.
10.	APU	Check.
	EGT	Within limits.
	Start master	Off.
	Fire switch	Auto.
11.	Single engine taxy	As required.
	Provided that, Reverse Idle rpm has not been exceeded and the APU is running:	
	No.1 Eng booster pumps	Off.
	No.1 Eng HP cock	Close.
	No.1 Eng oil LP lamp	Pull.
	No.1 EDP hydraulic lamp	Pull.
	No.1 Booster pump and engine LP lamps	Pull.
	No.1 Generator fail lamp	Pull.
	Hydraulic pressures	Check.

Note: Single engine taxy saves fuel at the rate of 6 kg per minute.

12.	Air conditioning	Set.
	Air delivery valve	Open.
	Air crossfeed valve	Open.
	Master valves	APU.

ENTERING THE PARKING AREA:

13.	Engine anticing	Off.
14.	Hydraulics/brake pressures	Check.
15.	Booster pumps	Off.
16.	Master warning lamps	Cancel.

SHUTDOWN

1.	Handbrake	On, 2800 psi.
2.	HP cock levers	Shut.
3.	No. 1 aux pump	Off.
4.	Seat belt, beacon, emerg lights	Off.
5.	Windscreen and side window heat	Normal and On.
6.	Landing and turn-off lamps	Retract, off.
7.	Air conditioning	Off unless required.
	Master valves	Closed.
	Air crossfeed valve	Closed.
	Air delivery valve	Closed.
	Temperature controls	Off.
	Cooling fan	Isolate
8.	Warning lamps	Reset.
	No.1 Eng oil LP lamp	
	No.1 EDP hydraulic lamp	
	No.1 Booster pump and engine LP lamps	
	No.1 Generator fail lamp	
9.	Hydraulics	Check contents.
	Contents	Top of green sector.
10.	Gust damper lamp	On.
11.	Fan intake shutter	Auto.
12.	Oxygen system	Check contents.
13.	Side windows	Locked.
14.	Roof panels	Dimmer switches off.
15.	Handbrake	Off, when chocks in position.
16.	APU	Shutdown unless required.
	Wait at least one minute after switching off air delivery valve.	
17.	Battery switch	Off if APU shutdown.
18.	Tech log	Complete.

FULL SHUTDOWN:

19.	Air conditioning	Off.
	As for Shutdown.	
20.	Isolation valves	Closed.
21.	LP cocks	Shut.
22.	Windscreen and side window heat	Off.
23.	VG switch	Off.
24.	Radars	Off.
25.	A.Pilot, A.Throt, Radios	Off.
26.	APU	Off.
	Wait at least one minute after switching off air delivery valve.	
27.	Battery switch	Off.

FLIGHT WITH MAIN ENGINE GENERATOR/CSDS INOPERATIVE

Operating Limitations

1. Passengers and goods may be carried for hire and reward.
2. APU must be serviceable for in flight use.

NOTE: Serviceability must be established before each AD sector by using the following abbreviated check.

1. With no main engine generator connected to the AC busbars, bring the APU generator on line.
2. Observing the APU KVA meter on roof panel E, select electrical loads to the approximate total value of 30KVA max.

   NOTE: Recommended loads are the ground conditioning fan and standby hydraulic pumps 1 and 2.

3. Select APU air for preferably both systems. Maintain 1 minute and then select off.

If, at any time during the above procedure, the APU fails to sustain continuity of electrical supply, the APU must not be considered "Serviceable for in flight use" in the allowable deficiency context.

The above check will normally be carried out by engineering and the Technical Log annotated accordingly. Details are listed to cater for situations where licenced engineering cover is not available.

ALTIMETER SETTING AND CHECKING

GENERAL

Captains are to obtain a forecast QNH for aerodromes of intended landing prior to departure as a routine part of their Met forecast information. This figure is to be noted on the Prepared Nav Log.

When a QFE or QNH is given to a decimal, the figure is to be rounded down to the nearest whole number except when carrying out altimeter checks on the ground.

At each flight phase the appropriate setting (QFE, QNH or 1013) is to be used on each altimeter, and not reversed as between Port and Starboard; this is particularly important when P2 is carrying out the landing.

AFTER FULL CHECKS

Set aerodrome QFE on all altimeters and check calibration error for altimeter serviceability. This error is not to be applied to subsequent readings because it is affected during flight by instrument lag and changes of static system position error, due to airspeed and angle of attack.

Set aerodrome QNH on the Starboard and Standby altimeter and cross-check aerodrome elevation.

AFTER TURNROUND CHECKS

Set the QFE on the Port altimeter and the QNH on the Starboard and Standby altimeters and cross-check aerodrome elevation.

AFTER TAKE-OFF up to and including Transition Altitude:

1. when cleared to an Altitude, set aerodrome QNH on the Port altimeter, crosscheck altitude and report vertical position as Altitude.

2. when cleared to a Flight Level, and in any case before climb above the Transition Altitude, set 1013 on the Port and Starboard altimeters, cross-check Flight Level, and report vertical position as Flight Level.

   The setting to QNH or 1013 will normally be done at or near the end of the noise-abatement climb procedure.

CRUISE:

Whenever, during cruise, terrain clearance is likely to be marginal (i.e. less than 2,000 ft) set the QNH value most suitable to the sector on the Standby altimeter, or if terrain clearance is not marginal set forecast destination QNH.

DESCENT down to and including the Transition Level:

Set destination aerodrome forecast or actual QNH on the standby altimeter.

When cleared to an Altitude and in any case before descending below Transition Level, set aerodrome QNH on all altimeters, cross-check altitude, and report vertical position as Altitude.

The QNH value received from ATC prior to approach and landing is to be checked against the forecast figure to ensure that there is no obvious discrepancy indicating the possibility of error.

FINAL APPROACH:

Set aerodrome QFE (or touchdown QFE when available) on the Port altimeter and cross-check elevation against Starboard altimeter.

The QFE value received from ATC is to be approximately cross-checked by applying the simple rule of 30 ft per millibar, or by comparing the difference between the Port and Starboard altimeters when set on QFE and QNH respectively, the difference corresponding correctly to the aerodrome or runway threshold elevation.

At aerodromes where there is a difference of 60 ft or more between the QFE datum (or the official aerodrome elevation) and the runway threshold elevation, altimeter crosschecks are to be carried out using aerodrome QNH and touchdown QFE (when available) for the runway in use.

Set aerodrome (or touchdown) QFE on the Starboard altimeter and cross-check reading against the Port, except when carrying out an SRA procedure using advisory Altitudes (QNH), when the Starboard altimeter is to remain on QNH throughout the approach for use with the appropriate QNH Decision Height for the SRA procedure.

OVERSHOOT

Set aerodrome QNH on the Starboard altimeter, and report vertical position as Altitude at or below the Transition Altitude. Set Port altimeter as required, according to whether another approach or a diversion is necessary.

NOTE In states that issue clearances below Transition Level based on QFE use the following altimeter setting procedures:

ARRIVAL. When cleared below Transition Level, set QFE directly on both main altimeters do not set an interim QNH. Cross-check QFE against forecast, and verify airfield elevation by reference to the standby altimeter set to QNH.

DEPARTURE. Set QFE on both main altimeters until passing Transition Height, then set 1013. Set QNH on the standby altimeter.

Use the Engine Check Start take-off procedure, Flight Handling 8. The rotation technique is the same as for a normal take-off, except that care must be taken to avoid over-rotation and consequent ground contact by the rear fuselage, due to the increased elevator effectivity at the higher V_R.
Climb initially at V_{FU} until clear of obstacles when normal flight handling may be resumed.

(c) Landing

The normal flapless landing and overshoot procedures apply.

V_R and V_2 Tables

Aircraft Weight kg	V_R	V_2
29300	126	136
29800	127	137
30200	128	138
30600	129	138
30900	130	139
31300	131	140
31600	132	141
32000	133	142
32400	134	143
32700	135	144
33000	136	145
33400	137	146
33700	138	147
34100	139	148
34400	140	149
34600	141	149
34800		

Aircraft Weight kg	V_R	V_2
34800	142	150
35200	143	151
35500	144	152
35900	145	153
36200	146	154
36600	147	155
36900	148	156
37200	149	157
37500	150	158
37900	151	159
38200	152	160
38500	153	161
38900	154	162
39200	155	163
39600	156	164
39900	157	165
40200	158	166
40400		

Altitude and temperature adjustment to V_R

Temperature	Airfield Elevation	
	Below 1000 ft	1000 ft to 2000 ft
Below 25°C	0	+ 1 kn
25°C to 30°C	0	+ 2 kn
Above 30°C	+ 1 kn	+ 2 kn

FLIGHT WITH APU INOPERATIVE

PRE-FLIGHT

1. Check Allowable Deficiencies:
   Vol 1 Tech, APU.

2. Performance Manual:
   Extract the Max Take-off weight for the flap setting and surface conditions and reduce by the appropriate Cabin Bleeds On correction. If the resulting weight will permit the required payload and fuel to be carried, take-off may be made using engine air for air conditioning, as described in column A below. If there is insufficient weight, take-off with master valve at APU as described in column B below.

3. Take-off Thrust Indices Bleeds-On
   If using Bleeds-On correction use the data on the next page to determine the take-off thrust indices. (Reduced thrust is permissible).

ENGINE STARTING

Details in Flight Management - Engines

AIR SYSTEM HANDLING

	A BLEEDS-ON	B BLEEDS-OFF
After Engine Start (Air cond - Set)	Master valves-Open Air del - Closed X-feed - Closed	Master valves - Open Air del - Closed X-feed - Closed
Before Take-Off	Master valves-Open Air del - Closed X-feed - Closed	Master valves-APU Air del - Closed X-feed - Closed
After Take-Off	No action required	After power cut back: No 2 MV - Open Pause 5 seconds No 1 MV - Open
Engine failure on on Take-Off	No action required	At 1500 ft: No 2 MV - Open No 1 MV - Open
Final Approach	No action required unless OAT is above 25°C or airfield elevation is above 2200 feet, in which case, Air del - Closed X-feed - Closed Master valves - APU	

ELECTRICAL SYSTEM

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FIG 1 ELECTRICAL SYSTEM PANEL 1
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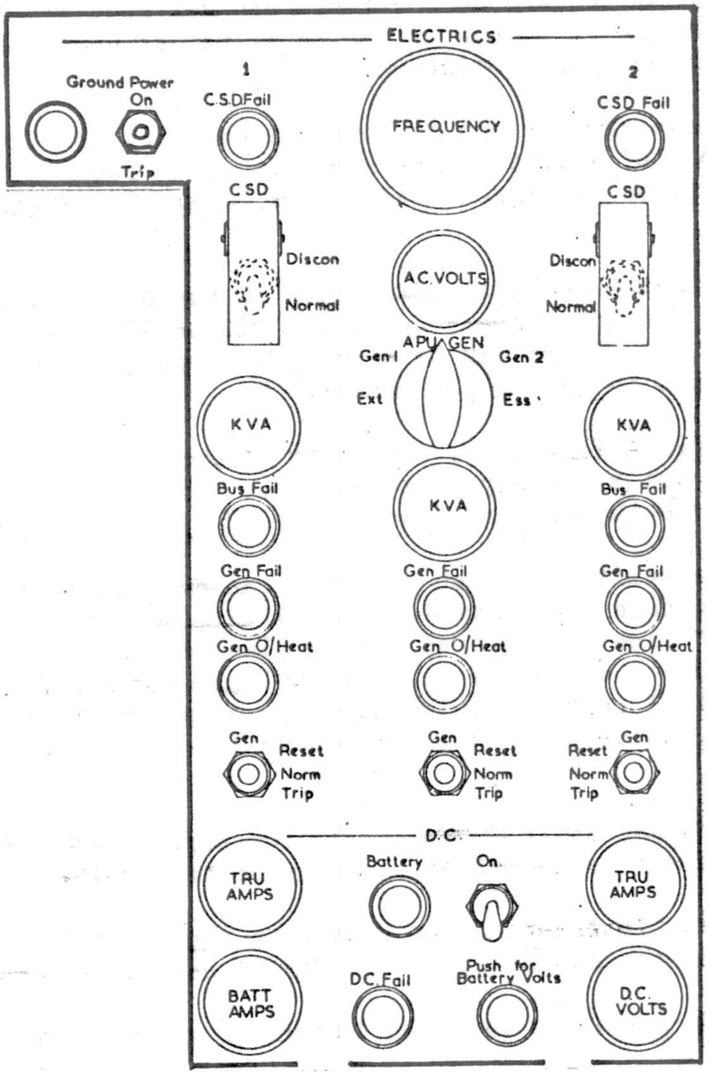


FIG.1 ELECTRICAL SYSTEM PANEL

GENERAL. Each engine drives a 30kVA brushless generator producing a closely regulated 400 c/s 115/200V 3 phase supply. Generator drive is taken from a Constant Speed Drive & Starter unit (CSDS) which turns the generator at 6000 rpm throughout the engine speed range from ground idle to take-off power. The output frequency is thus strictly regulated at 400 c/s so inverters are not required in normal flight. The system is virtually automatic in normal conditions and to some extent in abnormal conditions.

Each generators' output is taken via a Generator Circuit Breaker (GCB) to its' associated AC Bus Bar. This feeds a TRU which in turn supplies the associated DC Bus Bars. See Fig.2.

Each generator and its' associated AC Bus Bar remains quite separate from the others in normal flight and shares the aircraft load. The bus bars may be connected in parallel in certain circumstances but no generators can be.

A third 30kVA generator, driven at a constant 6000 rpm by the APU, produces the same supply as the other generators and may replace either or both of them at any time.

Control circuits for each generator automatically maintain the output voltage and current within limits and switch the generators on or off line as required. They also protect the channel against under or over-voltage or voltage instability, over-current, differential current faults and over or under frequency, any one of which faults will cause the control circuits to open the relevant GCB.

A single phase 26V 400 c/s supply for engine, airframe and flight instruments is provided by a number of transformers.

A 300VA static inverter may provide a single phase 115V 400 c/s supply for the Essential AC Bus Bar in certain circumstances.

Two 24V 25 A.h. (at 1 hr rate) batteries are carried.

AC and DC external supplies may be connected; the DC for APU starting only.

The system controls and indicators are all mounted on the roof panel as shown in Fig.1.

GENERATION

GEN switches (3). Marked 'Trip' 'Norm' 'Reset', the switches are sprung to 'Norm' and control the generators as follows:-

'Norm'. In this position the system is allowed to function automatically so that when a generator is rotated, the self-exciting field current it produces is passed to the field windings. An output is thus produced ready for connection to the AC Bus Bar. If at any time voltage and current requirements are not met the field circuit is opened thus collapsing the generators' output.

When the generator's output reaches acceptable limits, in the case of the APU the GPB (if closed) and SSB are opened and 1A & 2A GCB's are closed thus energising both 1 & 2 Main AC Bus Bars. See Fig.2. If Generator 1 now comes within limits, 1A GCB is opened and 1 GCB closed so that 1 Main AC Bus is fed from Generator 1 in place of the APU generator which continues to feed 2 Main AC Bus. Generator 2 reaching limits now causes 2A GCB to open and 2 GCB to close thus supplying 2 Main AC Bus in place of the APU which remains available if needed.

In flight, with the APU closed down, failure of Generator 1 or 2 will cause the associated GCB to open and the SSB to close, leaving the remaining generator supplying 1 & 2 Main AC Bus Bars. Pantry Supplies 2 & 3, the Bar Unit, the Air Conditioning Fan flight control supply and 1 (AUX) Hydraulic Pump if 2 (AUX) Hydraulic Pump is selected are then automatically shed. If the APU is now started, its' generator output, on coming within limits, will open the SSB and close the relevant 1A or 2A GCB so that the failed generator is replaced by the APU. The shed loads are then automatically re-connected.

If necessary, the automatic closure of the SSB may be prevented by tripping the 'AC Split' circuit breaker on the aft end of Panel P.

If a second generator, APU or main, were to fail, the above loads would again be shed, the SSB closed and the remaining generator would continue to supply both Main AC Bus Bars.

Continued/..........

Failure of this last remaining generator would allow the AC Changeover Relay to relax. This would switch the Essential AC Bus Bar from 1 Main AC Bus to the Inverter and, provided the Battery switch was On, close the Inverter Supply Relay to energise the Inverter from the Essential DC Bus. See Fig. 2. The DC Main Bus Isolation Relay would open and the aircraft could then continue for a further 45 minutes with the Essential AC Bus, the Essential DC and DC Sub Bus Bars, the Battery and Battery Sub Bus Bars all energised from Batteries 1 & 2.

'Trip'. The generator field circuit is tripped open to prevent or collapse any output.

'Reset'. This resets the relay that opened the field circuit at 'Trip' and must be selected momentarily before any generator output is possible if 'Trip' has been selected.

KVA METERS (3). One for each generator, calibrated 0 to 40 as shown in Fig.1, these show the load, in kilo Volt-Amps, when the generator is on line.

FREQUENCY METER
AC VOLTMETER
SELECTOR SWITCH. The switch (see Fig.1) connects the meters to the Ext(ernal supply), Gen 1 or 2, the APU Gen or the Ess(ential AC Bus). The voltmeter is calibrated from 70 to 130V.

The frequency meter is calibrated from 300 to 500 cps. The sector 380 to 420 cps is coloured green and indicates the frequency range over which the control circuits operate normally. The amber sectors either side have no significance.

GEN FAIL warning lamps (3) Amber, one for each generator. Generator 1 and 2 lamps come on when their GCB's are open. The APU generator lamp comes on when 1A and 2A GCB's (see Fig.2) are open and either or both 1 and /or 2 GCBs are open, all provided that the Essential DC Bus is energised. The lamps are connected to the amber **MWS.**

GEN O/HEAT warning lamps (3). Amber, one for each generator, these come on if the generator temperature reaches 177°C. They are connected to the amber **MWS.**

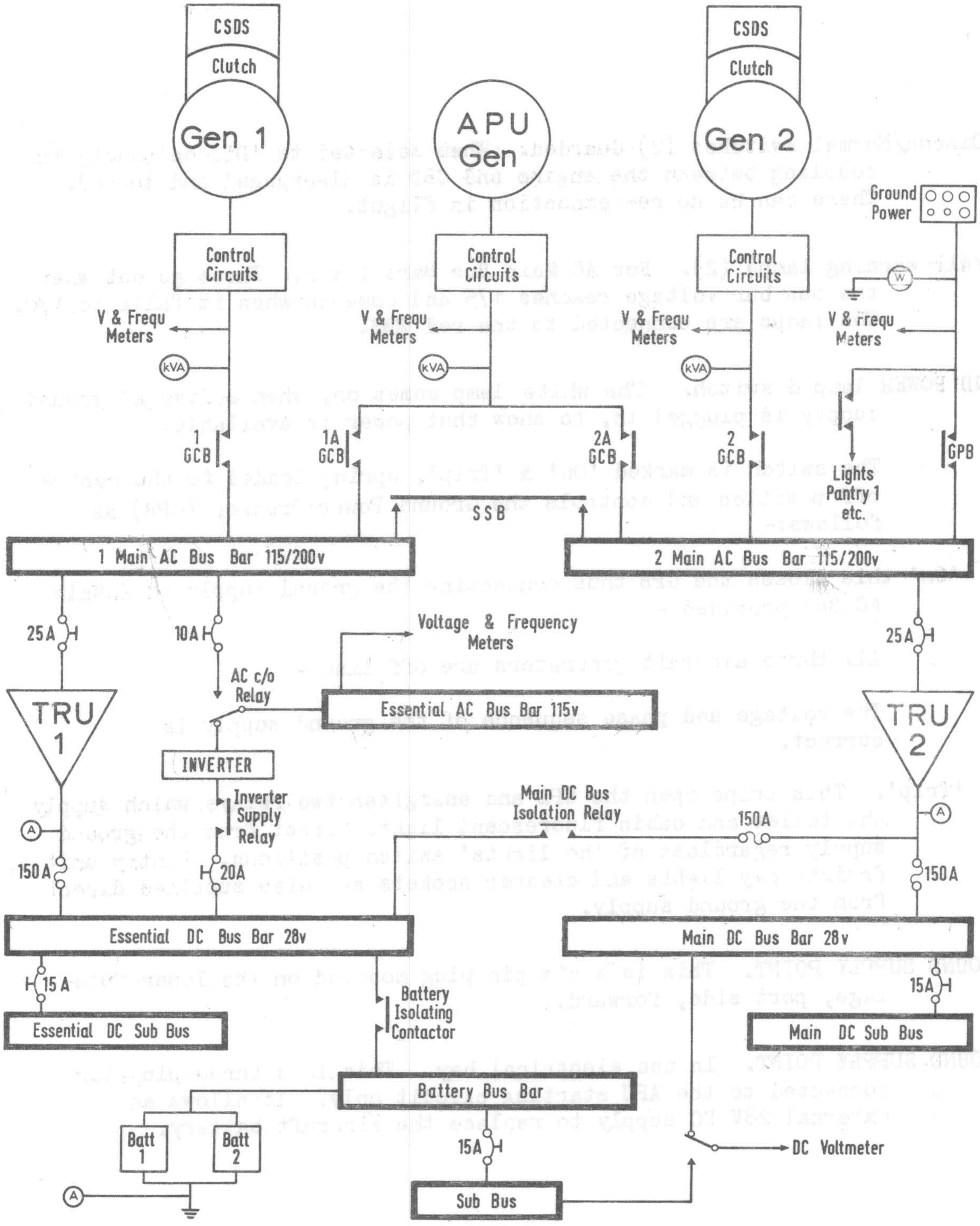


FIG. 2 ELECTRICAL SYSTEM

CSD Discon/Normal switches (2) Guarded. When selected to 'Discon'(nect) the coupling between the engine and CSD is disengaged and locked. There can be no re-connection in flight.

BUS FAIL warning lamps (2). For AC Main Bus Bars 1 & 2. These go out when the bus bar voltage reaches 175 and come on when it falls to 170. The lamps are connected to the red MWS.

GROUND POWER lamp & switch. The white lamp comes on, when a live AC ground supply is plugged in, to show that power is available.

The switch is marked 'On' & 'Trip', spring loaded to the centre off position and controls the Ground Power Breaker (GPB) as follows:-

'On' this closes the GPB thus connecting the ground supply to 2 Main AC Bus provided -

All three aircraft generators are off line -

The voltage and phase sequence of the ground supply is correct.

'Trip'. This trips open the GPB and energises two relays which supply the toilet and cabin fluorescent lights direct from the ground supply regardless of the lights' switch positions. Pantry unit 1, freight bay lights and cleaner sockets are also supplied direct from the ground supply.

AC GROUND SUPPLY POINT. This is a six pin plug mounted on the lower fuselage, port side, forward.

DC GROUND SUPPLY POINT. In the electrical bay. This is a three pin plug connected to the APU starting circuit only. It allows an external 28V DC supply to replace the aircraft battery.

AC DISTRIBUTION

1 Main AC Bus

- Fuel booster pumps
  - port tank fwd,
  - stbd tank aft.
  - port t'fer pump centre tank
  - 1 Top temp ctrl.
- Hyd pump 2
- Anticing side & main
  - windscreens port.
  - 1 eng air press gauge
  - Ice det motor
  - Waste water pipes
  - Water system
  - 1 Stall rec vane
  - 1 Stall wrg & auto ign vane
  - Q Pitot port
- Cockpit Voice Recorder
- Elect Essential AC Bus normal
  - TRU 1
- Air Cond Fan.
  - Pressn control
  - Toilet fan
  - 1 Primary temp ctrl.
  - F. Deck temp ctrl.
  - Radio Cooling Fan 1
- Pantry supplies. Bar unit (fwd
  - port) & No.3/4 (aft stbd)
- Lighting F. Deck f'scent
  - Landing ctrl & fils port
  - Cabin roof port
  - Toilets port
- FCS & Radio supplies
  - See FCS & Radio

Essential AC Bus

- Fuel contents gauges
- Hyd acc press gauge
  - Brake acc press gauge
  - (t'fmr)
- Inst. Altimeter port
  - Turn & Slip port
  - S.By Horizon
- Eng 1 & 2 TVI
  - 1 & 2 oil press gauges
  - (t'formers)
  - O'heat control
- Fire det eng & zones 1 & 2
  - Det APU
- Flap posn inds (t'formers)
  - Elev trim tab ind
  - (t'former)
- Radio supplies
  - (See FCS & Radio section)

Cont'd. ...

2 Main AC Bus

- Fuel booster pumps
    - port tank aft,
    - stbd tank fwd.
    - stbd t'fer pump centre tank
    - 2 Top temp ctrl

- Hyd pump 1
    - Brake press applied
    - gauges port & stbd
    - Anti-skid test

- Anticing side & main
    - windscreens stbd.
    - 2 Eng air press gauge
    - 2 Stall rec vane
    - 2 Stall wrg & auto ign vane
    - Q Pitot stbd
    - Drain outlet
    - Toilet water system

- Elect TRU 2
    - Pantry load shed relay

- Air Cond.
    - Cabin temp ctrl.
    - 2 Primary temp ctrl.
    - Radio Cooling Fan 2

- Pantry supply No.1 (fwd stbd)

- Inst. Altimeter stbd.
    - Turn & Slip stbd

- Lights cabin roof stbd
    - Toilets stbd
    - Landing ctrol & filament stbd
    - Anti-coll bcn motors

- FCS & Radio supplies
    - See FCS & Radio.

DC SUPPLIES

TRU. There is no control switching for the TRU's which are energised, 1 and 2 respectively from 1 & 2 Main AC Bus Bars. TRU 1 feeds the Essential DC Bus and TRU 2 the Main DC Bus with 28V DC, via a 150A fuse in each case, supplies being automatically available whenever the Main AC Bus Bars are energised.

TRU AMMETERS (2). Calibrated to 200 Amps, these show the load on each TRU. Limitations are given in Management.

DC FAIL warning lamp. Red. This comes on to show that there is no output from either TRU, or that their output voltages have fallen below 24.5, and that the Main DC Bus and Main DC Sub Bus Bars are isolated from the other DC bus bars. See Fig.2.

The Main and Essential DC Bus Bars are normally connected together so that failure of either TRU will not leave the associated DC bus bars unenergised. Connection is via the Main DC Bus Isolation Relay which closes, provided the Essential DC Bus is live, when the Main DC Sub Bus Bar voltage rises above about 26. The Battery Bus is also normally connected to the Essential DC Bus so as to keep the batteries fully charged. To prevent the load on all six DC bus bars falling on the batteries in the event of failure of both TRU's, the Main DC Bus Isolation Relay opens when the Main DC Sub Bus Bar voltage falls to 24.5 thus shedding the Main DC Bus and Sub Bus Bar loads.

The DC Fail warning lamp is energised, via relaxed contacts on the relay, from the Main or Essential DC Bus and is connected to the red MWS.

BATTERIES. Two 24V 25 A.h. (at 1 hr rate) batteries are carried in the electrical bay. They are permanently connected to the Battery Bus to which is connected, via a 15A cb, the Battery Sub Bus Bar. The Battery Bus Bar may also be connected to the Essential DC Bus Bar via the Battery Isolating Contactor (See Fig.2) which is closed when the Refuel Master switch is On, the hydraulic DC Pump switch is at 'Brake Acc' or the Battery switch is on.

BATTERY switch. This is simply a lock toggle on-off switch in the Battery Isolating Contactor coil circuit.

BATTERY ISOLATED WARNING LAMP. Amber, adjacent to the Battery switch. This comes on when the Battery Isolating Contactor is open, provided the Essential DC Bus is energised, to remind that the batteries are not being charged. It is connected to the amber MWS.

On the ground with the Battery switch off and no engines or APU running, it shows that an AC external supply is connected and switched on.

BATTERY AMMETER. Calibrated -100 to +100 Amps.

This shows the rate of battery charge or discharge.

DC VOLTMETER
PUSH FOR BATTERY VOLTS button. The DC voltmeter, calibrated from 18 to 30V, is normally connected to the Main DC Bus Bar and therefore shows the voltage on this and the Main DC Sub Bus Bar, the Essential DC Bus Bar and Essential DC Sub Bus Bar all of which are normally connected together.

Cont'd. ...

The 'Push For Battery Volts' button transfers the voltmeter to the Battery Sub Bus Bar thus showing the voltage on this and the Battery Bus Bar provided also that the Battery switch is off. Otherwise, the voltage will be the same as if the button were not pressed.

DC DISTRIBUTION

MAIN DC BUS BAR

Fuel flowmeters 1 & 2
    LP w/lts eng & booster
    Temp gauge
    Transfer valves p & s
    Top temp & dip ctrl

Air Cond fan (ground) ctrl
    2 TC V posn ind
    2 MV duct & CAU w/lts
    Main temp ind
    Cabin temp ind
    2 isol valve & system fail w/lt
    Heat exch outlet shutter
    Crossfeed valve

Hyd S.By steering valve solenoid
    Aux pump motor o'heat w/lts
    Off load solenoid
    Flying ctrls 1 & 2 w/lts

Stall rec cont & ind 2 system

High speed warning 1 & 2

U/C lever lock system

OAT gauge

Domestic water level w/lt
    and chlorine test.

Flap overspeed w/lt.

Eng 1 & 2 igniters 2
    Air crossfeed valve ctrl
Elect Main DC Sub bus bar
    DC Fail w/lt
    Bus isolating rel.
    Test sockets

Anticing pitot heater stbd
    Valves syst 2 wing & tail
    Valves eng 1 & 2 stbd
    Windscreen u'heat w/lts:
    o'heat ctrl & w/lts.
    Wing 2 duct press ind
    Visual ice detector
    heaters
    Drain mast heater
    Rain repellent
    Temp ind wing

Lights, nose & wing landing
    Turn-off
    Anti-collision
    Entrance & step
    F. Deck chart P 1 & 2
    Inst pillar
    Service
    Passenger reading & notices
    Door warning
    Ice inspection p & s

FCS & Radio supplies
    (see FCS & Radio section)

MAIN DC SUB BUS BAR

- Stall prot system 2
- Elect DC u/volt det amp

ESSENTIAL DC BUS BAR

- Fuel LP w/lts 1 & 2 syst
  - Transfer LP w/lt
  - Refuel control
- Anticing valves eng 1 & 2 port
  - Valves syst 1 wing & tail
  - Ice detector
  - Tail & duct 1 press gauge
  - Temp ind tail
- Air Cond fuse duct fail w/lt
  - 1 & 2 Isol valves & system fail w/lts
  - 1 TCV posn & MV inds
  - 1 MV Duct & CAU o'heat w/lt
  - Pressn discharge valve ind
  - Pressn safety valve
  - Pressn ram air valve
  - Cabin alt w/lt
  - Pantry fan
- Hyd fluid contents gauge
  - Syst 1 & 2 isoln valves
  - Syst 1 & 2 o'heat w/lt
  - Syst 1 & 2 LP w/lt
  - S.By brake press gauge
  - U/C w/lts & relays
  - S.By steering LP w/lt
  - Anti-skid system
- FL100 lamps
- FCS & Radio supplies (see FCS & Radio section)
- U/C lever lock system
- Cockpit Voice Recorder relay & mic. amplifiers
- Eng 1 & 2 thrust rev unlocked w/lts
  - Oil temp gauges
  - Oil LP w/lts
  - Start master
  - Fire & o'heat zone 1 & 2 w/lts
  - Fire bottle indicators
  - Air crossfeed ind
- Elect Ess sub bus bar
  - W/Lts test
  - Gens fail & o'heat w/lts
  - S.By inverter
  - Bus fail w/lts
  - Battery isolated w/lt
  - Ground power control
  - Main DC bus isol rel coil
- Flying Ctrls servo fail w/lt
  - Servo power MI
  - Lift dumper ctrl & MI's
  - Tail trim posn ind
  - Emerg elevator ctrl
  - Stall rec 1 syst ctrl & ind
  - Flap lower solenoid
- Lights essential cabin
  - Inst panel flood
  - Stewards call
  - Emergency 1 & 2 systems
  - Red & White flood
  - Roof panel
- APU fuel pump
  - Eng control
  - Gen fail & cooling w/lts

ESSENTIAL DC SUB BUS BAR

Fuel LP cocks
    Crossfeed cock MI

Lights, comp & console

Fire bell

Stall prot system 1

Configuration & U/C wrg

Eng fire botts 1st shot
    1 & 2 igniters 1
    CSD 1 & 2 disconnect

APU fuel valve
    Fire detector

Pitot heater port

Battery Bus Bar

Battery sub bus bar

APU start & ctrl

Hyd DC pump

Nav lights

Battery Sub Bus Bar

Eng fire botts 2nd shot

APU fire bot

F. deck roof light

Service intercom

Water system fill valve

MASTER WARNING SYSTEM (MWS)

MASTER WARNING lamps (4). One red and one amber are mounted together on each main instrument panel. The lamps flash to draw attention to the warning lamps listed below, red ones indicating that instant action is required, amber that attention is necessary. A 4 seconds delay on all but the first seven warning lamps in the red list prevents transient conditions from operating the flashers.

Red

Eng O/heat
Oil LP
Ice Warn
Cabin Altitude
Servo Fail
Elev Emerg Fail
A/Throt diseng
(with GP captured)
Booster Pump LP
DC Fail
Bus Fail
Fuel Trans LP
Eng Fuel LP
APU Oil LP
Windscreen O/heat
Windscreen U/heat
Standby Steer LP
Radio Fans Fail
Compass Comparator
FD ATTitude
Flap Overspeed
Flap Shaft Fail

Amber

Gen O/heat
Gen Fail
Battery Isolated
Air Systems Fail
Air Master Valve Closed
Hyd O/heat
Hyd Fail
Hyd Aux Pump O/heat
Spoiler Fail
Elevator Emerg LP
Feel fail

Continued/....

In the air, flashing of the Master Warning lamps would be normally cancelled by pulling out the head of the system warning lamp which caused the flashing. The system warning lamp then remains on as a reminder that attention is required and the MWS is then ready for further warnings. The flashing would also be cancelled by the disappearance of the reason for the system warning light. Alternatively, the flashes may be totally inhibited by pulling out the heads of all four Master Warning lamps. This would usually be done on the ground to prevent continuous flashing when aircraft systems are not operating normally, and to avoid the necessity of pulling out the heads of a large number of system warning lamps. With their heads pulled out, the Master Warning lamps show a steady light, provided that the Essential DC Bus is energised.

The MWS may be tested by pressing any of the system warning lamps shown above. The Master Warning lamp heads must be in their normal operating position and the 4 second delay will still obtain, where relevant.

DISTRIBUTION PANELS

GENERAL. Circuit breakers and four fuses are carried on panel B, circuit breakers only on panel P on the flight deck and on the pantry panels. They are all titled with the circuit they protect. A red lamp inside panel B comes on when the Main AC Bus Bars are live and would be seen if the panels were opened. Another red 'power on' warning lamp is fitted in panel J in the electrical bay.

OLEO CONTROLLED SYSTEMS

GENERAL. Operation of the systems listed below is automatically modified, according to whether the aircraft is in flight or on the ground, by a number of relays. These are arranged in two groups and energised, when weight is on, via micro-switches on the main oleos, one group through the port switch and the other through the starboard. The port and starboard groups of relays are each again divided into two sub-groups and all four sub-groups have separate power supplies, through the 'Landing Gear Relays (Left & Right)' circuit breakers on panel 'B', from the Essential DC Bus Bar.

The port switches control relays 10, 12, 16, 28, 43, 45, 64, 72, 97.

The starboard switches control relays 9, 11, 15, 29, 42, 44, 63, 71, 96.

System	Ground	Flight
Relays energised via cb's B242 & B244		
Relays 11 & 12		
Cooling fan flap	'Auto' Flap open 'Shut' Flap shut	Flap shut
Gen cooling c/o	Induced air	Ram Air
Port Turn & Slip S.By Horizon	Inoperative with HP fuel cocks closed.	Operative
S.By steering	Operative	Inoperative
Relays 9 & 10		
Ice detector	Inop. except when 'Ice Test' at 'Test'.	Operative
Stall prot (stick push)	Inoperative	Operative (Not 'Test')
U/C up selection	Inop without excessive force	Operative
Gen cooling c/o	Induced air	Ram Air
Relays 28 & 29		
Main Brakes A/Skid	Operative	Inoperative
Relays 42 & 43		
Stall warning	Inoperative	Operative
Auto ignition	Inoperative except when 'Auto Ign Test' switch operated	Operative
Stall prot (stick push)	Inoperative	Operative (Not 'Test')
Pantry supply 2, 3 & 4 and bar unit	Normal	Shed if Conditioning Fan on.

System	Ground	Flight
Relays energised via cb's B243 & B245		
Relays 71 & 72		
Airframe antice	Inoperative except at 'Test'.	Operative
Relays 96 & 97		
Main Brakes A/Skid	Operative	Inoperative
CVR Erase	Operative	Inoperative
Relays 44 & 45		
Stall protection (stick push)	Inoperative	Operative (Not 'Test')
Stall warning	Inoperative	Operative
Auto ignition	Inoperative except when 'Auto Ign Test' switch operated	Operative
Relays 63 & 64		
Gust damping	Operative with both hyd systems off.	Inoperative
Lift dump	Operative	Inoperative
Hyd Aux pump 1	Operative with Load Shed Relay at shed, and hyd Aux Pump 2 'On'.	Inoperative with Load Shed Relay at shed, and hyd Aux Pump 2 'On'.
Relays 15 & 16		
T'off config warning	Operative	Inoperative
Cooling fan motor	'Normal'. Operative	Operative only with U/C selected down, airspeed below 165 kts, load shed control relay open and hyd Aux Pump 2 switched off.

/Cont'd. ...

System	Ground	Flight
	Relays energised via cb's B243 & B245	
Relays 15 & 16 (Cont'd)		
Drain mast heater supply c/o	Main DC Bus	2 Main AC Bus
Stbd T & Slip	Inoperative with HP fuel cocks closed	Operative
Flt recorder	Stops 30 secs after weight on if 'Stop' switch not used.	Starts if 'Start' switch not used. 'Insert Ident' inhibited.

LIGHTING EXTERNAL

NAV lights On/Off switch. Roof panel. This controls conventional wing tip and dual white tail navigation lights. The tail lamps, mounted on the aft end of the bullet may have only one filament on at any time as determined by a switch.

DUAL TAIL marked Upper-Lower. Aft steward's panel. This is a changeover switch for the white, tail navigation lights.

BEACON On/Off switch. Roof panel. This is a double pole switch controlling supply relays for the upper and lower fuselage mounted rotating anti-collision beacons. Each beacon has two filaments both of which are lit when the switch is On. The filaments are DC fed, the motors AC.

RUNWAY TURN OFF LIGHTS switch. Roof panel. This is a double pole on/off switch controlling via relays, the 28V DC to both the turn-off lamps. These are 250W each and are mounted, with a 45° outward squint, in the wing roof fairing.

LANDING LAMPS switches (5). Roof panel. Landing/Taxi lamps, one in each wing and beneath the nose, are controlled by these switches as follows:-

'Retract' - 'Extend' switches (2). The port switch controls both the wing lamps, the starboard switch the nose lamp. The 115V AC 'extend' supply to the wing lamp actuators is automatically cut off in the fully extended position; the 'retract' supply likewise when the lamps are fully retracted. The 28V DC supply to the nose lamp actuators is similarly controlled.

'Main' (2) 'Nose' (1), 'Taxi' - 'Off' - 'Land' switches. The port and starboard 'Main' switches control the corresponding wing lamps, which each have 400W and 600W filaments, as follows:-

'Taxi'. A relay controlling the 115V AC supply to the lamp units is closed bringing the supply to another switch which is closed only if the lamp is extended to 8.5° and beyond. The 115V is then transformed down to 26V and fed to the 400W filament. The 600W filament is not lit as it's circuit is opened by a further relay.

'Off'. All five filaments, four main and one nose, off.

'Land'. This acts in the same way as the 'Taxi' position but additionally the 600W filament is lit, giving a total of 1000W of landing lighting on each wing.

The 'Nose' switch controls a relay, switching 28V DC to the 250W nose lamp, in both the 'Taxi' and 'Land' positions. The lamp may be lit when fully retracted.

LIGHTING INTERNAL

EMERGENCY LIGHTS

GENERAL Two emergency lighting systems are provided. System 1 incorporates 15 lamps, energised from the Essential DC Bus, mounted in the normal lighting fittings and located -

Both forward doors 1 each
Cabin roof 10
Aft vestibule 1
Toilets 2

These lights come on, regardless of any other switch position, when the 'Fasten Seat Belts' switch is 'On', provided the Essential DC Bus is live. They are also partly controlled by the 'Emerg Lts' switch as shown below.

System 2 has 16 self-contained, nickel-cadmium battery driven, twin filament, solid-state electronically switched units located -

Flight deck 1
Both forward doors 1 each
Overwing emergency exits (4) 1 each
Aft vestibule 1
Top of ventral steps 1
Bottom of ventral steps 1
Cabin roof 6

All but those in the last two locations listed incorporate their own 'On' - 'Arm' switch and may be unshipped and used as hand lamps. Their switches would normally be at 'Arm' when fitted to the aircraft but may be put 'On' if other switching had failed.

EMERG LTS switch, marked 'On' - 'Arm' - 'Off'. Roof panel.

'On'. System 1 and 2 lights come on, provided the Essential DC Bus is energised. This is required only initially for System 2 unit switching. System 2 batteries charging from the Essential DC Bus.

'Arm'. Normally in this position in flight, it allows System 1 lights to come on automatically if the Main DC Bus Bar is de-energised, and System 2 lights to come on if 1 & 2 Main AC Bus Bar voltage falls to 170, provided the Essential DC Bus is energised to provide the initial switch-on supply for System 2 and permanently for System 1. System 2 batteries being charged from the Essential DC Bus.

'Off'. This must be selected to put System 2 lights out, however they were switched on, before returning the switch to 'Arm'. The automatic function of both systems is inhibited but System 1 lights will come on if 'Fasten Seat Belts' is put 'On'.

ROOF switch. Port roof panel. An On/Off switch controlling a single white lamp in the flight deck roof fitting.

FLIGHT DECK RED FLOOD switch. Port roof panel. A dimmer switch controlling a single red lamp in the flight deck roof fitting.

PEDESTAL FLOOD
RED - WHITE switches (2). Stbd roof panel. Dimmer switches controlling red and white lamps in the flight deck roof fitting.

CHART LT switch. P3 panel. A dimmer switch controlling a single white lamp in the flight deck roof fitting to light P3 position.

PANEL LTS switch. P3 panel. A dimmer switch controlling P3 panel Plastek type lighting.

STORM switch. Port roof panel. An On/Off switch controlling the port and stbd. fluorescent lamps beneath the glareshield.

ROOF PANEL switch. Port roof panel. A dimmer switch controlling Plastek type lighting of the port, centre and stbd roof panels.

CHART switches (2). Port & stbd roof panels. Dimmer switches controlling adjustable lamps mounted above P1 and P2.

PORT PANEL
FLOOD RED WHITE switch. Port roof panel. A double dimmer switch controlling the port instrument panel red and white floodlighting.

PORT PANEL
PILLAR switch. Port roof panel. A dimmer switch controlling the port instrument panel pillar white lighting.

CENTRE PANEL
FLOOD RED WHITE switch. Port roof panel. A double dimmer switch controlling the centre instrument panel red and white floodlighting.

CENTRE PANEL
PILLAR switch. Port roof panel. A dimmer switch controlling the centre instrument panel pillar white lighting.

STBD PANEL
FLOOD RED WHITE switch. Starboard roof panel. A double dimmer switch controlling the stbd instrument panel red and white floodlighting.

STBD PANEL
PILLAR switch. Starboard roof panel. A dimmer switch controlling the stbd instrument panel pillar white lighting.

COMPASS switch. Starboard roof panel. An on/off E 2B Compass light switch.

RADIO CONSOLES

DIALS PANELS switches. Starboard roof panel. These are double dimmers controlling radio and panel lighting on the pedestal and, on the starboard console, the oxygen regulator panel, 2 Weather Radar controller, brake temperature gauges, stick push indicators and APU TGT gauges. On the port console the Flight Recorder and 1 Weather Radar controllers.

BRIGHT-OFF-DIM switch. Panel P. A changeover switch controlling the red, Plastek type, cb panel lighting.

MAP TABLE switches (2). Port & stbd, above nose steering wheel. Dimmers controlling adjacent white lights.

WHEEL WELL switch. Roof panel. On/off switch controlling white lights in each wheel well and master-controlling the electrical bay lights.

ON-OFF switch. Electrical bay, on the battery structure. Controls two electrical bay lights under master control of 'Wheel Well' switch.

ON-OFF switches (2). At hold doors, controlling ten lights in forward hold and six in the aft. Supply for these lamps is taken from the ground supply direct when one is plugged in but the GPB is open; from the Main DC Bus otherwise.

SPARE BULBS. These are carried in three stowages in the inboard edge of panel B.

DME IND DIM. Port instrument panel. Controls DME Indicator external lighting.

FUEL SYSTEM

FUEL QUANTITY gauges (3), one for each tank, on centre instrument panel. Calibrated in kg to show amount of usable fuel in tanks.

TRANS PUMPS switches (2), on centre roof panel. Up 'On', down off. Control the transfer pumps in the centre tank.

TRANS LP warning lamp (1), amber, press-to-test, on centre roof panel. Connected to MWS Amber. If the fuel pressure in the fuel transfer line falls whilst either transfer pump is switched on, the warning lamp will come on, the refuel/defuel valves will close, and the MIs show cross-line.

TRANSFER COCK switches (2), on centre roof panel, marked "Trans Valve". When selected up to On, provided that the transfer line is pressurised and the warning lamp out, and that the master switch on the external fuel control panel is Off, the associated refuel/defuel valves will open for fuel transfer from the centre tank. Float switches will automatically close a valve if the wing tank becomes full before transfer is complete.

TRANSFER COCK magnetic indicators (2) on centre roof panel, marked 'Trans Valve'. Show amber when there is no 28V supply or when the master switch on the external fuel control panel is On, irrespective of refuel/defuel valve position, otherwise showing in-line or cross-line in accordance with valve position.

BOOSTER PUMPS switches (4), on centre roof panel. Up 'On', down off. Labelled 'Front' and 'Rear' for each wing tank.

CROSSFEED COCK magnetic indicator (1), on centre roof panel, marked 'X-Feed Valve'. Shows amber when no electrical supply, cross-line when cock is closed, and in-line when cock is open.

CROSSFEED COCK (1), on centre roof panel, marked 'X-Feed Valve', up 'Shut', down 'Open'. When at 'Open', either wing tank can be used to feed both engines or, after engine failure, both tanks can feed the remaining engine.

LP COCK switches (2), on centre roof panel, marked 'LP Valve'. Up 'Open', down shut. Each controls the LP cock for its associated engine and provides the means of isolating the engine from the aircraft fuel system. They are lock-toggle switches and are normally at 'Open'. An engine's LP cock will close automatically when its fire control handle is pulled, provided that the HP cock lever has been set to

'Shut'. To open an LP cock the appropriate LP cock switch must be selected Open, and the HP cock lever selected Start or Open.

LP COCK magnetic indicators (2), on centre roof panel, marked 'LP Valve'. Show amber when there is no 28V supply, or when HP cock is shut whilst LP cock is selected Open (will show cross-line when LP cock is subsequently shut). When HP cock levers are at 'Start' or 'Open', indicators show cross-line if LP cocks are closed and in-line if they are open.

BOOSTER PUMP LP warning lamps (2), red, press-to-test, on centre roof panel. Each lamp is controlled by a pressure switch in the pipe line at the nacelle, and gives warning of low booster pump pressure. Connected to the red master warning system via a 3-7 second delay circuit.

ENGINE LP warning lamps (2), amber, press-to-test, on centre roof panel. Give warning of low pressure in the engine fuel system immediately downstream of the flowmeter. Connected to the amber master warning system.

FUEL TEMP gauge (1), on centre instrument panel. Dual indicator, calibrated -60°C to +120°C for each engine. Indicates the temperature detected by a transmitter at the fuel heater outlet. Fuel from the backing pumps passes to the heater through the fuel-cooled oil cooler; the fuel heater uses HP compressor delivery air as necessary to further raise the fuel temperature above +5°C, to prevent the formation of ice. Control of the heater is automatic.

FUEL CONSUMED gauges (2), on centre instrument panel. Indicate in kg the total weight of fuel used by each engine. Can be set to zero by turning the reset knob on the gauge through 90°, and then pushing it.

FUEL FLOW indicators (2), on centre instrument panel. Show the rate of fuel flow through each engine in kg/hr. An internal by-pass valve in the flowmeter transmitter ensures a free fuel flow at all times.

HP COCK levers (2), on control pedestal, marked 'HP Fuel'. Up 'Open', centre 'Start', down 'Shut'. Spring-loaded knob on each lever must be pulled to free plunger on lever from detent on quadrant before lever can be moved. Cocks control the passenge of fuel from the flow regulator unit to the combustion spray nozzles. When at 'Shut' each lever also operates micro-switches, preventing the LP cock 'open' solenoid from being energised, and causing the CSDS air shut-off valve to close; when at 'Open', the electrical supply to the 'open' coil of the shut-off valve is maintained. The 'Start' position allows a greater flow of fuel than does the 'Open' position, thus facilitating starting.

/Cont'd. ...

The lever will be locked in the open position and the HP cock will close if the associated engine's LP compressor shaft should fail.

A red lamp in the head of each lever will light to indicate:-

1. Engine fire warning.
2. Engine overheat warning.
3. Engine oil low pressure warning.

When the lever is set to Shut, the lamp will go out.

| APU control switch (1), on centre roof panel. Up 'On', down off. When set to 'On' the APU LP cock opens. The cock will close when:

1. The control switch is set to off.
2. The APU fire control handle is pulled.
3. The fire shutdown switch on the external control panel is set to 'Fire'.
4. The APU automatic extinguishing circuit operates.

APU LP COCK magnetic indicator (1), on centre roof panel, marked 'Fuel Valve'. Shows cross-hatch when no electrical supply, or 'Open' or 'Closed', according to the position of the cock.

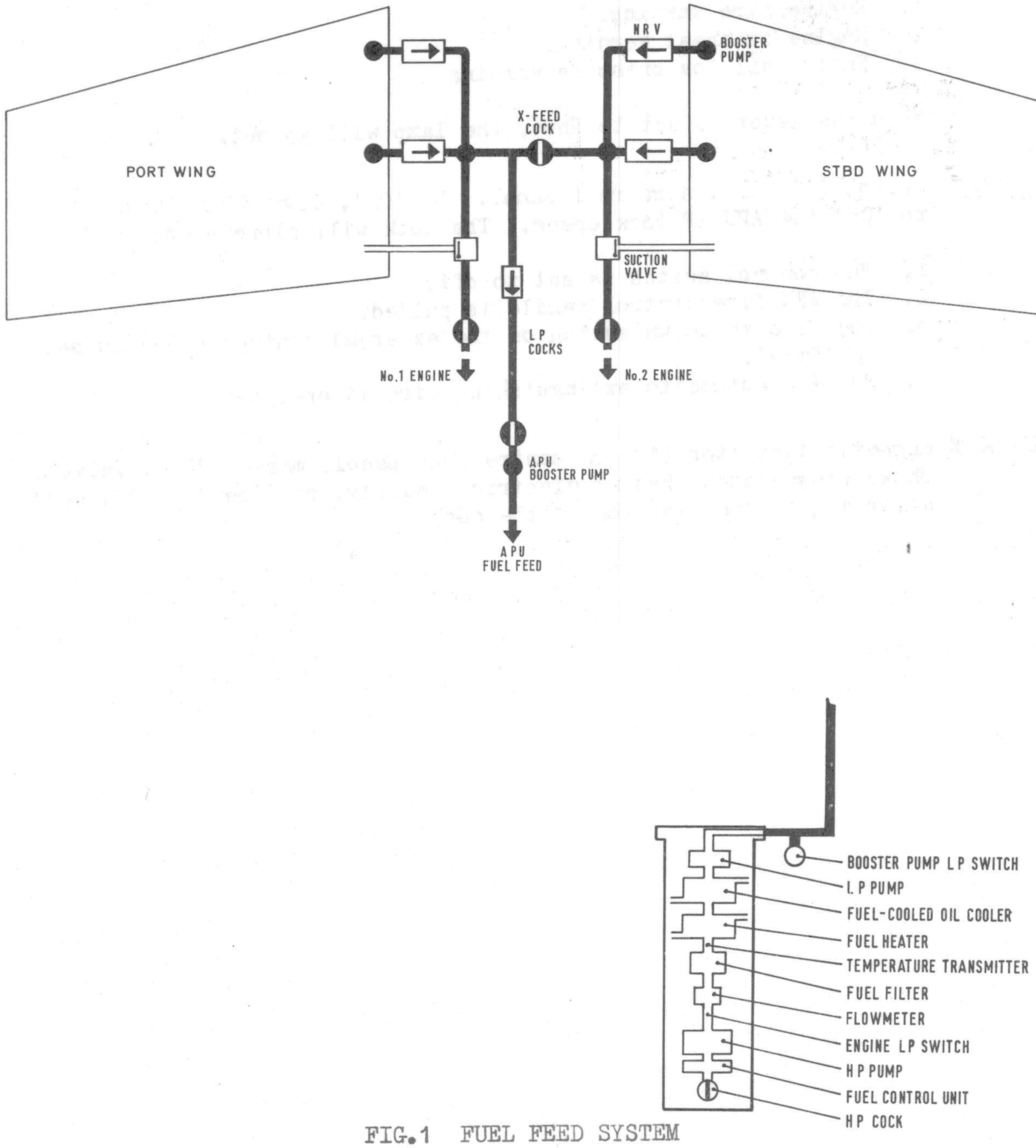
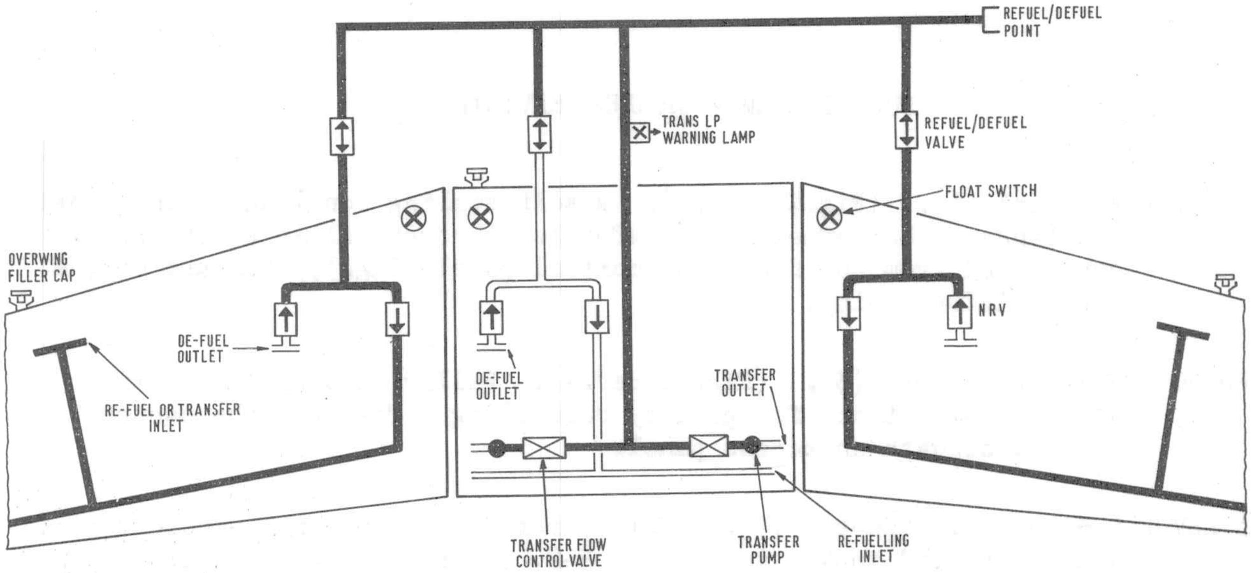


FIG.1 FUEL FEED SYSTEM



SOLID BLACK LINES INDICATE PIPES PRESSURISED AS DURING FUEL TRANSFER

FIG.2 REFUEL/DEFUEL AND TRANSFER SYSTEMS

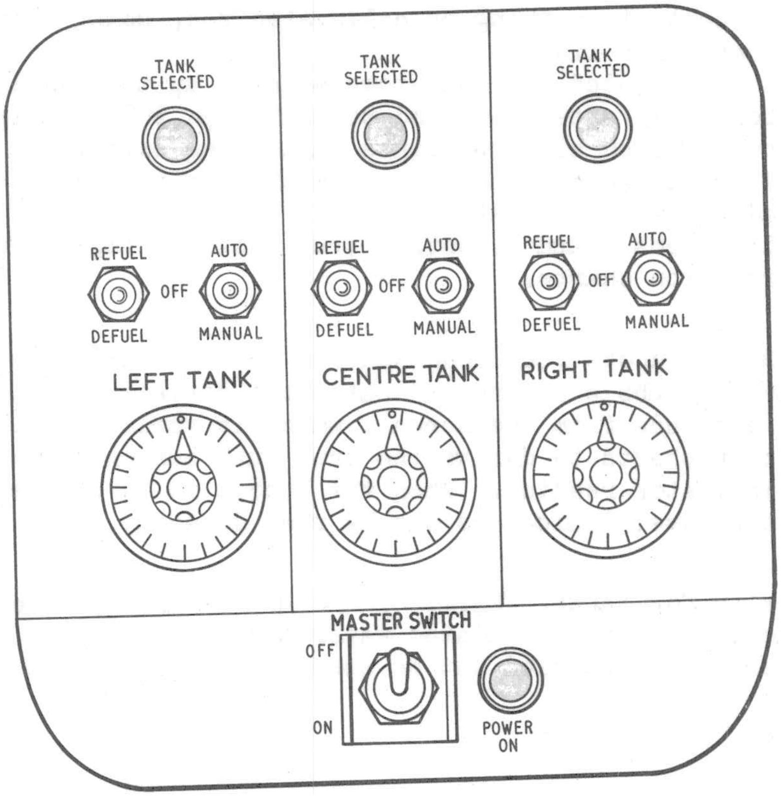


FIG.3 FUEL LOAD CONTROL PANEL

FUEL SYSTEM - GROUND SERVICING

REFUEL/DEFUEL point (1). (Fig.4, Ref.B). A self-sealing coupling which allows all tanks to be refuelled or defuelled through valves electrically controlled from the fuel load control panel (Fig.3), forward of the refuel/defuel point.

OVERWING REFUELLING POINTS (3). (Fig.4, ref.A). Filler caps which provide access to the tanks for gravity refuelling. That for the centre tank is beneath an access panel.

FUEL LEVEL indicators, magnetic (9). (Fig.4, ref.C). Port tank - indicators 1-4, starboard tank - indicators 5-8, centre tank - indicator no.9. Calibrated in Imperial gallons. Used in conjunction with the attitude indicator and attitude correction charts to measure the tank contents when the aircraft is on the ground.

Instructions for use:

1. Using a screw-driver, press and turn 90° in either direction to release calibrated rod.
2. Pull gently on stowage latch to check correct extension; magnetic attraction should be felt.
3. Read contents marking on calibrated rod, using content register as reference line.
4. Push calibrated rod and stowage latch up through locking cover immediately after use, and turn through 90° to align slot in stowage latch with red lines on locking cover.
5. Release stowage latch and check that it is locked.
6. Read attitude indicator.
7. Using items 3 and 6, obtain true contents figure from attitude correction charts.

ATTITUDE INDICATOR (1), above fuel load control panel. Calibrated in $\frac{1}{2}^{\circ}$ squares. Position of bubble centre indicates the deviation of the aircraft's ground attitude from the normal, which is applied to the attitude correction charts to derive the true fuel contents from the magnetic level indicator reading. When the bubble is in square D4 (centre of grid) the level indicators may be read directly.

WATER DRAIN valves (6 for tanks, Fig.4, ref.D. 6 for pumps, in pump covers). Used to drain off accumulated water and for water content checks, which should be carried out as specified in the Pre-departure Check.

/Cont'd ......

Instructions for use:

Tank drain valve -

1. Using a screwdriver, turn clockwise through 90°.
2. Push spindle up, collect liquid in clean glass container.
3. Check the sample, as described in Vol.5, Sect.9, App 2.

Pump drain valve -

1. Unscrew to limit.
2. Push up, collect liquid in clean glass container.
3. Check the sample.

MASTER SWITCH (1), on fuel load control panel - Up 'Off', down 'On'.

When set to 'On':

1. Refuel/defuel system is energised from aircraft batteries, APU, or an external supply.
2. Power On lamp comes on.
3. Panel is illuminated.
4. Two relays interrupt the fuel transfer circuits and complete the circuits between the preselector units and their associated refuel/defuel valves and float switches.
5. Transfer cock magnetic indicators show Amber.

The switch is set to 'Off' by an interference bar when the panel access door is closed.

POWER ON lamp, (1), green, on fuel load control panel. Comes on when Master Switch is 'On', to indicate that power supplies are connected to the refuel/defuel system.

PRESELECTOR units (3), on fuel load control panel, marked 'Port Tank', 'Centre Tank', 'Starboard Tank'. When the required tank contents is set on the dial, and the Auto/Manual switch selected 'Auto', the refuel/defuel valve is opened to allow fuel to flow to that tank. The selector unit uses the fuel contents gauging system to measure actual tank contents, closing the refuel/defuel valve when the set load is achieved. The gauging system read-out is corrected for an assumed ground incidence of 0.5° nose-down, the flight deck contents gauges calibrated for a flight incidence, and this can result in a discrepancy between total fuel and the flight gauge readings.

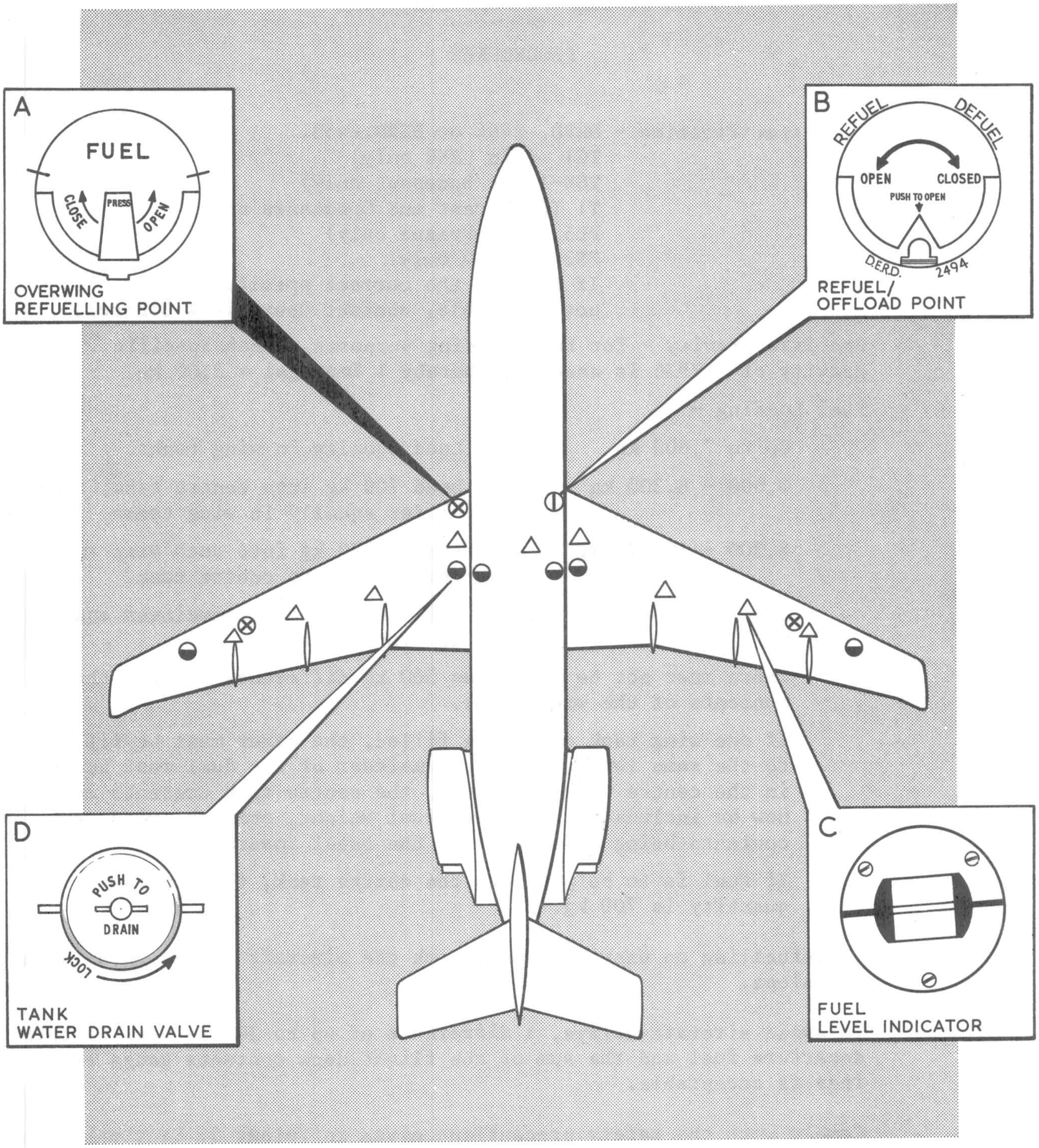
AUTO/MANUAL switches (3), on fuel load control panel. One for each tank, up 'Auto', centre 'Off', down 'Manual'. When set to 'Auto' the supply to the associated preselector unit is completed, allowing a tank to be refuelled or defuelled automatically to a pre-determined level. When set to 'Manual' the supply to the refuel/defuel valve is directly controlled by the Refuel/Defuel switch and the float switches.

REFUEL/DEFUEL switches (3), on fuel load control panel. One for each tank, up 'Refuel', centre 'Off', down 'Defuel'. Controls the supply to the solenoids of the refuel/defuel valve, either through the preselector unit or directly, according to the setting of the Auto/Manual switch. When refuelling at 'Manual', the flow can be stopped when desired by setting the Refuel/Defuel switch to 'Off', or alternatively when the tank is full by float switches in the tank which interrupt the supply to the refuel/defuel valve. The centre tank has one float switch, while each wing tank has two switches, both of which must operate to allow the valve to close.

TANK indicator lamps (3), green, on fuel load control panel. One for each tank, comes on when -

1. The Auto/Manual switch is at 'Auto' and
2. A fuel level has been set on the preselector unit and
3. The Refuel/Defuel switch is set to 'Refuel' or 'Defuel'.

The lamp goes out when the supply to the refuel/defuel valve solenoid is broken, either by operation of the preselector unit or by setting the Refuel/Defuel switch to 'Off'.



BLACK ARROW : TOP SURFACE
WHITE ARROW : UNDER SURFACE

FIG.4 FUEL SYSTEM SERVICING POINTS

FUEL SYSTEM - GROUND SERVICING

PROCEDURES

PRELIMINARIES

Fuel specification - DERD. 2494 or DERD.2453.
TC1 (in USSR only)
TSZ-1 (at Budapest only)
T1 (Bucharest and Constanza only)
PL5, PL6 (Prague only)
PS2 (Krakow only)
If fuel of the correct specification is not available, contact Operations Control.

Specific gravity - for fuel loading purposes a mean specific gravity of 0.7936 is assumed, whereby 1 Imp. gal = 3.60 kg.

Fuel Loading -

Up to 7,600 kg	- Load equally in wing tanks.
7,600 - 8,300 kg	- Load 700 kg into centre tank, remainder equally in wing tanks.
8,300 - 10,678 kg	- Load 3,800 kg into each wing tank, remainder into centre tank.
Greater than 10,678 kg	- Fill centre tank, remainder equally in wing tanks.

There must not be more than 500 kg difference between the contents of the wing tanks.

If one wing tank cannot be filled, the other must be filled to the same level, and the remainder of the fuel must be put in the centre tank. However, the centre tank contents must now be included in the zero fuel weight, only the wing tank contents being deducted from the total loaded weight.

If fuel is to be put into the centre tank, the minimum quantity is 700 kg.

If refuelling on uneven ground, park the aircraft facing up or down the slope.

To avoid aircraft delays, a difference of up to 200 kg between total departure fuel and the sum of the flight deck contents gauge readings is acceptable.

Comply with the safety precautions given in Volume 5, Section 3, and Section 9, Appendix 2.

PRESSURE REFUELLING OR DEFUELLING
AUTOMATIC FUEL LOAD CONTROL

Maximum refuelling rate	410 Imp. gal/min.
Maximum refuelling pressure	53 psi.
Maximum defuelling rate	130 Imp. gal/min.
Maximum suction	8 psi.

Tanks being refuelled or defuelled should be done simultaneously.

1. Electrical supply - aircraft battery, APU, or 200/115V 3 ph. 400 c/s external supply.
2. Ascertain fuel load required.
3. Defuelling only - operate tank water drain valves (fig.4, ref.D).
4. Check contents of each tank, using fuel level indicators (fig.4, ref.C) and attitude indicator for the wing tanks, and the fuel quantity gauge for the centre tank. (The fuel level indicator in the centre tank is inaccessible and should be ignored unless the quantity gauge reading is suspect).
5. Bond tanker or hydrant to aircraft.
6. Remove coupling cover (fig.4, ref.B), and connect hose to coupling.
7. Open access door to fuel load control panel.
8. Master switch - 'On', Power On lamp on.
9. Appropriate Auto/Manual switches - 'Auto'.
   Refuel/Defuel switches - as required.
10. Preselector units - set required load for each tank.
    Check that Tank indicator lamps are on.
11. Operate tanker or hydrant.
12. As each tank reaches the selected load, its indicator lamp will go out.
13. Check contents of each tank, as in item 4. Adjust loads if necessary.
14. All Auto/Manual switches - 'Off'.
    All Refuel/Defuel switches - 'Off'.
    Master Switch - 'Off', Power On lamp out.
15. Close and secure the fuel load control panel access door.
16. Disconnect hose and bonding. Fit cover to coupling.
17. Refuelling only - operate tank water drain valves.
18. Check fuel level indicators and water drain valves closed and locked.
19. Electrical supply - as required.
20. Check fuel uplift/offtake with supplier. Complete the Technical Log.

PRESSURE REFUELLING OR DEFUELLING
MANUAL FUEL LOAD CONTROL

As for Automatic Fuel Load Control up to and including item 8.

9. Appropriate Auto/Manual switches - 'Manual'. Refuel/Defuel switches as required.
10. Operate tanker or hydrant.
11. Using the tanker or hydrant meter as a guide, set the Refuel/Defuel switches to 'Off' when the desired tank contents are reached.
12. Continue with item 13 of Automatic Fuel Load Control.

OVERWING REFUELLING

1. Ascertain fuel load required.
2. Check contents of each tank, using fuel level indicators (fig.4, ref.C) and attitude indicator for the wing tanks, and the fuel quantity gauge for the centre tank. (The fuel level indicator in the centre tank is inaccessible and should be ignored unless the quantity gauge reading is suspect).
3. Bond tanker or hydrant to aircraft.
4. Place wing mats in position to protect top surfaces and leading edges.
5. Connect hose nozzle to bonding socket beside refuelling point cap, then remove cap and insert nozzle.
6. Refuel to required load.
7. Withdraw nozzle, disconnect bonding, replace cap.
8. Ensure cap correctly locked and, for centre tank, access panel closed and fastened.
9. Remove wing mats.
10. Check contents of each tank, as in item 2. Adjust loads if necessary.
11. When refuelling has been completed, disconnect tanker or hydrant bonding.
12. Operate water drain valves.
13. Check fuel level indicators and water drain valves closed and locked.
14. Check fuel uplift with supplier. Complete the Technical Log, writing 'Overwing' below the words 'Fuelling completed' in the certification box.

ENGINE INDICATORS AND CONTROLS

ENGINE OVERHEAT warning lamps (2), red, on engine indicator panel, centre instrument panel. One lamp for each engine firewire system (Zone 2) and cooling air overheat detector. Press to test the overheat detector circuit and lamp filament; the test circuit is held on until the associated LP Cooling switch is selected Reset. Both lamps come on when the Zone 2 test switch is selected 'Test', going out when the test switch is released to Off.

If the Zone 2 firewire detects a significant temperature rise, the associated warning lamp will come on, remaining on until the ambient temperature falls below the firewire reset temperature; if the overheat detector senses a rise in temperature of the engine cooling air through 460°C, the associated warning lamp is locked On until the air temperature has fallen and the associated LP Cooling switch is selected Reset.

An overheat warning brings on the appropriate engine HP Cock warning lamp and the Master Warning system.

REVERSER UNLOCKED indicator lamps (2), amber, on engine indicator panel. On when either thrust reverser clam shell in the associated engine is not locked in the fully open position.

ZONE 2 test switch (1), on engine indicating panel. Spring-loaded to up, 'Off' position. When pressed down, 'Test', completes a circuit through both engine firewire systems to bring on both overheat warning lamps if the systems are serviceable. The systems are reset and the warning lamps go out on release of the switch.

% THRUST gauges (2), on engine indicating panel. Calibrated to indicate developed engine thrust as a percentage of required take-off thrust from 50 - 110%. Each indicator incorporates a manual compensation for variations in ambient atmospheric conditions; the compensation to be applied is computed from tables as a digital thrust index, set by pressing and rotating the setting knob, and displayed digitally as a three-figure index (000 - 200) in a window on the instrument. When rotated without pressing, the setting knob also moves an index.

LP COOLING switches (2), on engine indicating panel. Spring loaded up to Off. Press and hold down to 'Reset' to cancel either engine overheat warning following test of either overheat detector circuit by pressing the warning lamp or operation of the overheat detector circuit following a rise above 460°C in the temperature of the engine cooling air.

HP RPM gauges (2), on engine indicator panel. Electrically operated instruments supplied from tachometer generators driven by the HP rotating assemblies of the associated engines. Main scale calibrated from 4,000 - 14,000 rpm in 1,000 rpm divisions; inset scale calibrated from 0 - 1,000 rpm in 100 rpm divisions.

TURBINE GAS TEMPERATURE gauges (2), on engine indicator panel. Calibrated 100 - 800°C in 100° divisions. Gas temperature is measured by thermocouples mounted radially in each engine exhaust assembly. The thermocouples additionally supply temperature indications to the Top Temperature Control system. Coloured sectors indicate temperature ranges for specified flight conditions, lubber lines mark specific TGT values.

LP RPM gauges (2), on engine starting panel, roof panel. Electrically operated instruments supplied from tachometer generators driven by the LP rotating assemblies of the associated engines. Main scale calibrated from 0 - 14,000 rpm in 1,000 rpm divisions; inset scale calibrated from 0 - 1,000 rpm in 100 rpm divisions.

FUEL FLOWMETERS (2), on engine indicating panel. Graduated 0 - 4,000 kg/hr, in 100 kg/hr divisions. By-pass type metering units fitted in each engine fuel line between the LP and HP pumps measure and transmit the rate of fuel flow to each engine.

OIL TEMPERATURE gauges (2), on engine indicating panel. Graduated from - 50 - 0 - +150°C in 10° divisions. Electrically-operated instruments supplied from thermometer/transmitter units mounted at the rear of each engine oil tank.

OIL PRESSURE gauges (2), on engine indicating panel. Graduated 0 - 75 psi in 5 psi divisions, electrically connected to pressure transmitter in each engine's oil filter outlet.

OIL LP warning lamps (2), red. Press to test. On when the associated engine's oil pressure falls through 15 psi. Connected to Master Warning system. Before shutting down an engine following a low oil pressure warning, the associated oil pressure gauge indication must be checked.

VIBRATION INDICATOR TEST buttons (2), mounted above TVIs, one for each engine monitoring system. Press to test system - an indication in the test range should be registered on the associated indicator.

TURBINE VIBRATION indicators (2) on centre instrument sub-panel. Calibrated 0 - 10 relative amplitude, in single unit divisions. Electrically-driven remote indicators connected via amplifier units to vibration pick-ups mounted on each engine. Amber sector from 5 - 10 rel amp. White line from 6 - 8 rel amp, marking test range.

TTC/AUTO IGN. DATUM CHANGE switches (2), on centre console, one for each engine. Three position switches, aft 'Off', centre 'TTC Only', fwd 'Arm Both'. Each switch has to be pulled out to make a selection; when released, the spring-loaded lever engages a detent. When either switch is selected 'TTC Only', the associated engine fuel regulator unit receives TGT indications: as the TGT of that engine rises to the Type Limitation maximum, the datum setting of the governor unit is altered to progressively reduce fuel flow and stop any further rise. When selected 'Arm Both', TTC is operative, and the Auto-Ignition trigger datum is changed.

THROTTLE levers (2), on centre console, moving in quadrants, connected by cables and lever systems to the engine speed governors in the fuel regulator units. The throttle levers are friction-damped to prevent creep. Auto-throttle disengage switches are fitted in the head of each lever. The reverse throttle levers are pivoted on the fwd face of the throttle levers.

Throttle lever movements adjust the datum setting of the engine speed governors, varying the HP pump output to achieve the required HP rpm. The governor unit datum is further, automatically, varied to maintain the selected rpm over the aircraft altitude and airspeed range, limit maximum rpm, and to prevent exceeding the limiting TGT when either TTC or Arm Both is selected.

The throttle levers should not normally be staggered when HP rpm are synchronised, but if LP rpm synchronisation has been used some throttle lever stagger will result and is acceptable.

/Cont'd. ...

The HP fuel pump delivery rate is additionally reduced to prevent an LP rotating assembly overspeed, controlled by an LP governor unit.

Microswitches in each throttle control linkage are associated with:

Take-off Configuration Warning system.
U/C Warning Horn circuit.
Overshoot Initiation circuit.
Lift Dump Control circuit.

REVERSE THROTTLE levers (2), one mounted on each normal throttle lever. Normally locked in the fully forward position by mechanical quadrant locks; the mechanical lock is disengaged when the normal throttle lever is pulled fully back to the 'Idle' position, and reverse thrust can then be selected. Pulling the reverse throttle lever up and to the rear progressively increases engine power; its initial movement actuates the pneumatic jacks to close the thrust reverser clamshells, the Reverser Unlocked warning lamp comes on, the normal throttle levers are mechanically locked in the Idle position, and a mechanical baulk restricts reverse throttle selection to 20% max reverse thrust. When the clamshells are fully closed, the baulk will be withdrawn.

Spring-loaded rollers engage in detents to give max reverse and reverse idle positions. The max reverse position corresponds to approx 60% full reverse thrust; full reverse thrust should only be used in emergency.

Fully closing the reverse throttle lever engages the 20% baulk and opens the clamshells. Once the clamshells have locked open the Reverser Unlocked lamp goes out, and the associated throttle lever is unlocked; forward movement of the normal throttle lever locks the reverse throttle lever in the closed position.

ENGINE STARTING

ISOLATION VALVE switches (2), on air system panel, Roof panel. Prime function - see 'Air Conditioning'. Prior to engine starting, the appropriate switch must be selected Open.

HP COCKS (2) on centre console - see 'Fuel'.

START MASTER switch (1), on engine starting panel, roof panel. 4 position rotary switch, 'Motor', 'Off', 'Start', 'APU'. When selected 'Start', the engine starting circuit is armed; selecting 'Motor' arms the air starter valves, but isolates the igniter circuits. The 'APU' position is not connected to the main engine circuits, but completes circuits to the APU Start button.

START/RELIGHT switches (2), on engine starting panel. Spring loaded to centre 'Off' position. With the Start Master switch selected 'Start', pressing the switch up 'Start & Motor' locks on the associated engine start relay, opens the air control valves to admit pressure air to the air motor, connects the LP Shaft Rotation lamp to the associated engine tachometer generator, and completes the engine igniter circuits. If a pressure reducing valve or air control valve fails to operate, a manual selection can be made by a ground engineer.

The HP stage is driven to above the engine's self-sustaining speed by the CSDS air motor; continued acceleration through 5,000 HP rpm brings the generator on line, automatically releasing the engine start relay.

If an engine start sequence has to be abandoned below 5,000 HP rpm, this can only be achieved by selecting the Start Master switch to 'Off'.

When pressed down to the 'Relight' position, the engine igniter circuits are completed; this position functions independently, with the Start Master switch in any position.

With the Start Master switch selected 'Motor', pressing the appropriate Start/Relight switch up will complete the starting circuits, except the igniter circuits; without ignition, the engine cannot be accelerated beyond self-sustaining speed, and the engine start relay will therefore remain locked on until the circuit is broken by selecting the Start Master switch to 'Off'.

IGNITER ON indicator lamps (4), two for each engine, amber. On engine starting panel, press to test, pull to isolate. One pair, marked '1' and '2', for each engine's dual igniter system; come on when the igniters on the associated engine are energised by an engine start selection, relight selection, or the Auto-Ignition system associated with the stall warning sensors.

LP SHAFT ROTATION indicator lamp (1), green, on engine starting panel. Press to test. Connected by engine starter switch to tachometer generator driven by the LP rotating assembly of the selected engine. Flashing on/off as LP assembly rotates, at frequency directly proportional to rotation speed.

GROUND SERVICING

ENGINE OIL FILLING pressure connections 2, one on the lower port side of each main engine.

Oil tank capacity - 7 litres (12 pints) to 'FULL' mark.

System total capacity - 12 litres (24 pints)

Usable oil - 5 litres (9 pints)

Oil specifications - Castrol 325 or WPS293.
Approved alternatives Aeroshell 390
Castrol 3C.

The required minimum oil level before flight is:-

First flight of day - *Full

Departure from base station - 1 litre (2 pints) below FULL.

Sector exceeding 2 hr - 1 litre (2 pints) below FULL.

Departure from any other Station,
provided sector does not exceed 2 hr - 2 litres (4 pints) below FULL.

*When replenishing from litre cans, it is permissible to exceed Full by ½ litre (1 pint).

Max Oil consumption - 0.75 litre (1½ pints)/hour, averaged over last ten hours flying.

When the consumption exceeds ½ litre (1 pint)/hour, averaged over last ten flying hours, the tank must be full 5 litres on every departure - See Tech Log E for information on oil consumption monitoring.

ENGINE STARTING

Suitable Ground Air Supply Units.

British: Blackburn Air Starter (Palouste).
Hampson Airmaster.
Auto-Diesel Gas Turbine starter.
IV Pressure Controller air bottle trolley.

Continental: Atlas Copco Air Partner.

American: Air Research Gas Turbine starter.

GROUND AIR CONNECTION (1), in stbd engine stub fairing. Provides inlet connection for ground air supply from suitable unit, for engine starting with no internal air supply function.

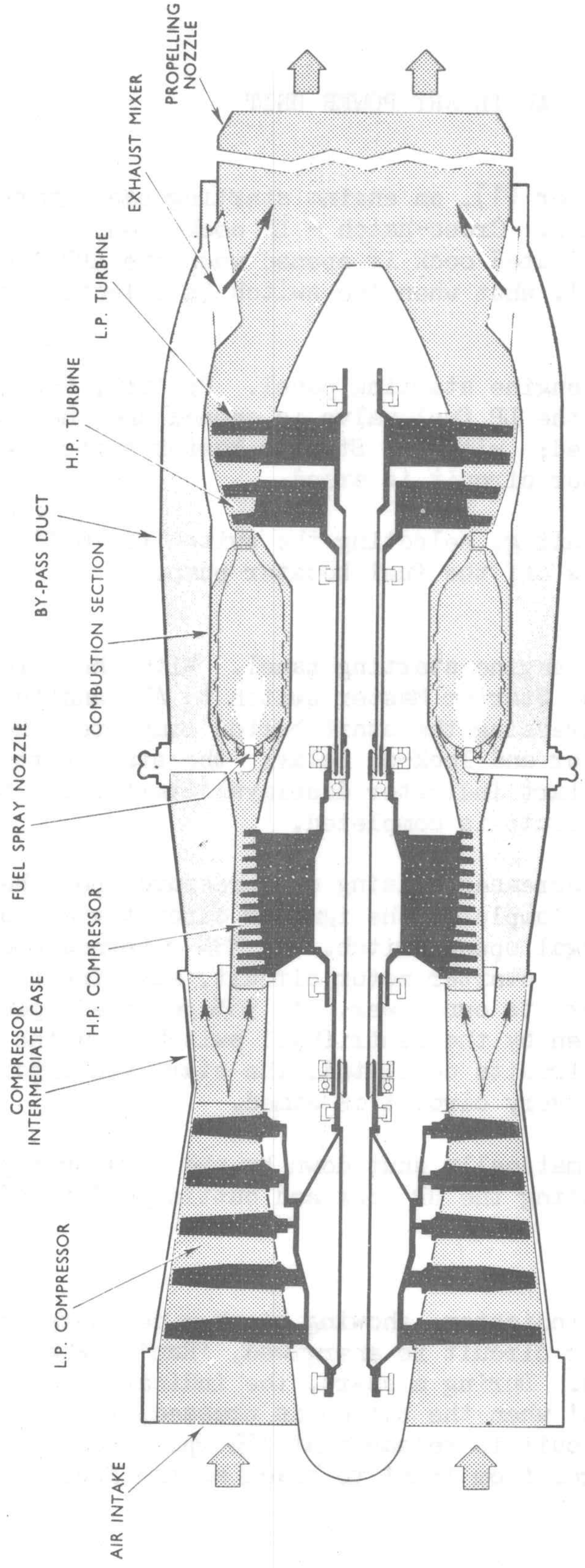

PROPELLING NOZZLE
EXHAUST MIXER
L.P. TURBINE
H.P. TURBINE
BY-PASS DUCT
COMBUSTION SECTION
FUEL SPRAY NOZZLE
H.P. COMPRESSOR
COMPRESSOR INTERMEDIATE CASE
L.P. COMPRESSOR
AIR INTAKE

FIG. 1 R.R. SPEY

AUXILIARY POWER UNIT

APU LP COCK magnetic indicator (1), on engine starting panel marked FUEL VALVE, roof panel. Cross-hatch - LP cock open, 'Closed' - valve shut. The associated cock is opened when the APU Control switch is selected 'On', shut when the switch is selected 'Off'.

APU CONTROL switch (1), on engine starting panel. Up 'On', down 'Off'. When selected 'On', the LP fuel valve is opened and the valve indicator circuit energised; with the Starter Master switch selected 'APU', the starter motor circuit is armed.

With the APU running, selecting the switch to 'Off' closes the LP cock and cuts off the fuel booster pump.

PUSH TO START button (1) on engine starting panel. With the circuit armed by selection of the Starter Master switch to APU and the APU Control switch to on, pressing the start button completes the circuit to the starter motor and lock-on relay; the start button can be released, the start indicator displays 'Start', and the fuel booster pump circuit is completed.

As engine rpm increases, rising oil pressure open the HP cock (or fuel valve) and completes the ignitor circuit via closed contacts on the centrifugal speed switch. At 35% governed speed, the speed switch breaks the starter motor circuit, allowing the engine to accelerate under its own power. At 95% governed speed, the igniter circuit is broken by the centrifugal switch, and the start counter and hourmeter circuits completed, the start indicator displays 'Run', and the air delivery circuit is armed.

The APU is automatically shut down by the 110% overspeed switch operating, shutting the HP cock and cutting off the fuel booster pump.

START INDICATOR. Magnetic indicator, showing black - de-energised, 'Start' - when the starter circuit is energised, 'Run' - when APU has reached 95% rpm. During a start, the indicator changes from black to 'Start' when the button is pressed, reverts to black as the starter circuit is released at 35% rpm. During shutdown, the indicator changes from 'Run' to black as the fuel cocks are shut.

APU EXHAUST GAS TEMPERATURE gauge, on stbd console. Graduated 0 - 1000°C in 100° divisions.

OIL LOW PRESS warning lamp (1), amber, on engine starting panel. On when APU oil pressure falls below 48 psi. Connected to the Master Warning System. The warning system is not energised whilst the APU control switch is selected Off, and disconnected from the MWS whilst the start master switch is selected to APU.

OVERSPEED TEST switch (1) on external APU fire control panel at rear of aircraft. Spring loaded to Normal. When selected 'Test', with the APU running at its governed speed, completes a circuit to open the air test solenoid.

APU FIRE SHUTDOWN switch.)
FIRE BOTTLE switch.)
MANUAL FIRE/AUTO switch.)
FIRE CONTROL handle.)
APU FIRE warning lamps.) - See 'Fire Protection'.
FIRE BOTTLE DISCHARGE indicator.)
FIRE ACCESS/BLOW-OUT panels.)
FIRE EXTINGUISHER PRESSURE RELEASE indicator)

AIR DELIVERY VALVE switch.)
AIR X-FEED VALVE switch and indicator) - See 'Air Conditioning'.

APU GROUND SERVICING

OIL TANK capacity - 0.83 imp gal.
OIL SPECIFICATION - Useable oil - 6 pints.
Castrol 325, Castrol 3C, WPS 293.
GRAVITY FILLER CAP.
PRESSURE FILLER CONNECTION. On APU oil tank.

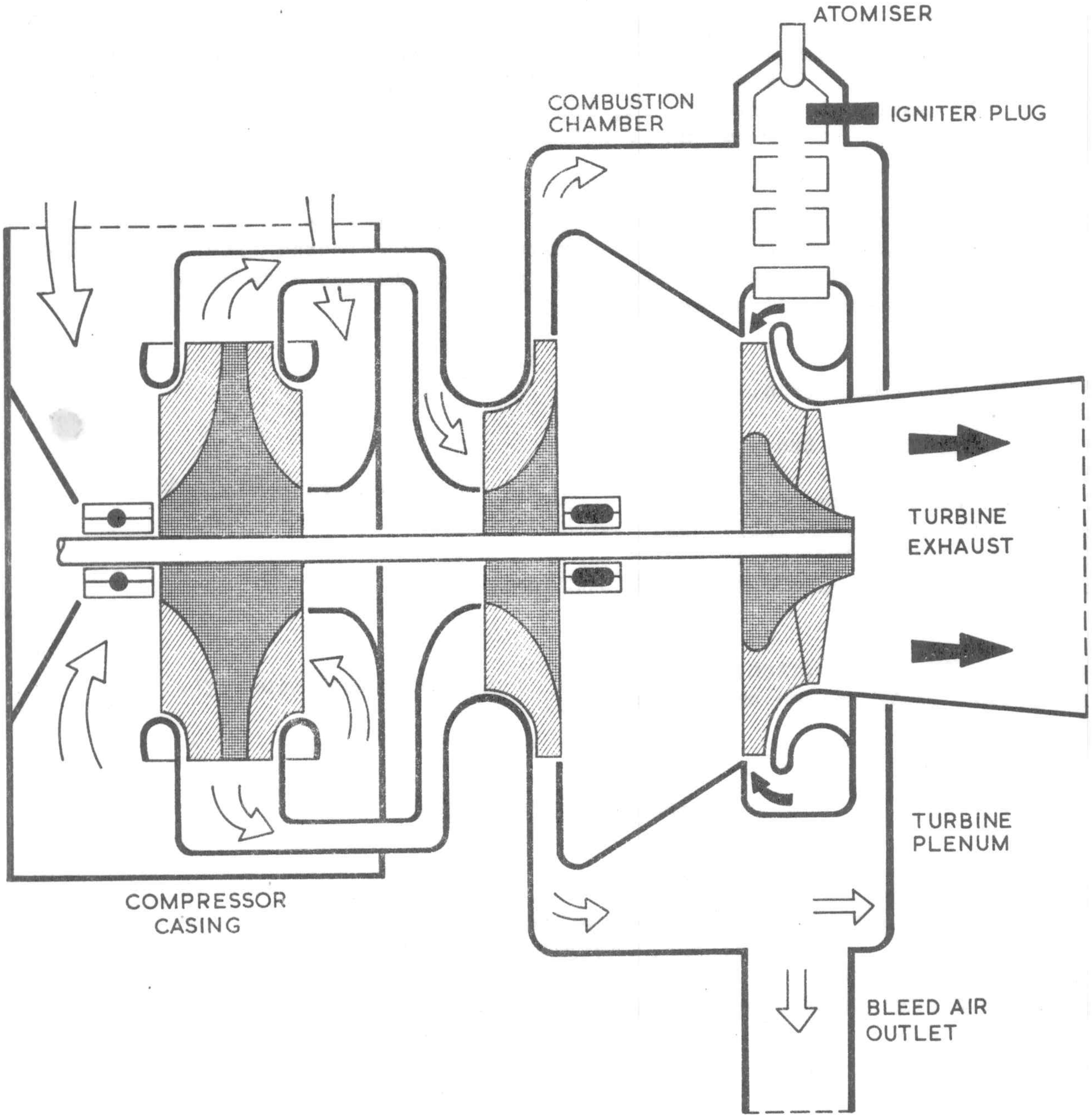


FIG.2 AUXILIARY POWER UNIT

HYDRAULIC POWER

SYSTEM PRESSURE gauge (1), on hydraulic control panel. Dual instrument, indicating the hydraulic pressure in each system, left pointer - No. 1 System, right pointer - No. 2 System; the two systems are independent, and hydraulic pressure is generated by either a variable-displacement engine-driven pump or an electrically-driven (AC) pump. An additional electrically-driven pump (DC) is located in No. 2 System to provide hydraulic power for emergency flap lowering or the ground operation of certain services. System pressure is normally controlled by the pump to 3,000 psi, and system pressure relief valves crack at 3,500 psi, opening fully at 3,800 psi to divert excess system pressure into the reservoir return line.

No. 1 System supplies (EDP or Aux pump):

Flying Controls (including flaps, outboard spoilers, feel units)
Lift Dumpers
Tailplane Incidence unit
Undercarriage system
Nosewheel Steering
Stbd Windscreen Wiper

No. 2 System supplies:

EDP or Aux pump -
Flying Controls (including flaps, inboard spoilers, feel units
Tailplane Incidence unit

EDP, Aux or DC pump -
Brakes, Foot and Hand
Ventral airsteps
Port Windscreen wiper

Aux pump only, from emergency reservoir -
Emergency Elevator system, including Feel

DC pump only, from system reservoir -
Emergency Flap system

With all the pumps inoperative, stored system pressure will fall rapidly, through dissipation into the reservoir return lines from the individual system components.

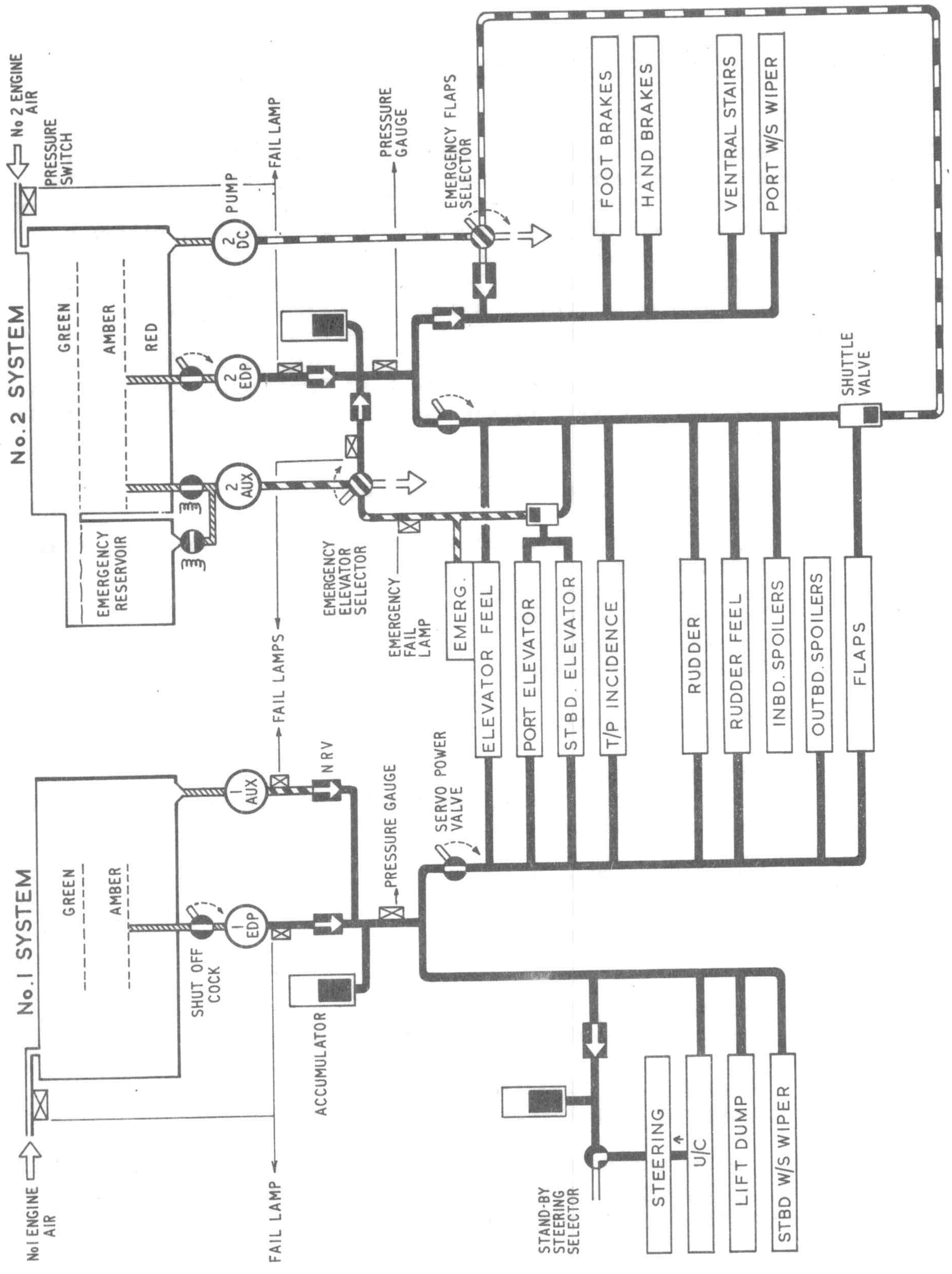


FIG.1 HYDRAULIC POWER SYSTEM

SYSTEM QUANTITY gauge (1), on hydraulic control panel. Dual instrument, indicating reservoir fluid levels, left pointer No. 1 System reservoir, right pointer No. 2 System reservoir. The scales are divided into three sectors:

Green:	Normal Flight range.
Amber:	Entered as fluid level falls due to systems operation or loss of fluid.
Red :	No. 1 system - outlet to EDP uncovered, Aux pump only available. No. 2 system - outlets from main reservoir to EDP and Aux pump uncovered, remaining contents available only to DC pump. The Aux pump can still draw fluid from the emergency reservoir to power the emergency elevator system.

No. 2 System reservoir is connected to an additional-capacity reservoir, which drains back into the main reservoir as the fluid level falls, and to the emergency reservoir. As the fluid falls to the amber range, the connection to the emergency reservoir is uncovered, and the fluid in that reservoir is available only for the Aux pump when supplying the emergency elevator system.

The reservoirs are pressurised by engine bleed air at 38 psi to provide a pressure head at the EDPs.

Each reservoir, excluding the additional capacity and emergency reservoirs, is provided with a sight glass.

OVERHEAT WARN lamps (4), amber, on hydraulic control panel. The outer pair of lamps are connected to thermostats in the hydraulic reservoirs. A lamp comes on when the fluid in the associated system reservoir rises to 85-95°C, remaining on until the temperature falls below this range. LH lamp connected to No.1 System reservoir. RH lamp to No. 2 System. Both lamps are connected to the Master Warning system. If either lamp comes on, the associated EDP and Aux pump should be switched off - the Aux pump can be switched on if the lamp subsequently goes out.

The inner pair of lamps are connected to thermostats mounted on the casings of the Aux pump motors. A lamp comes on when the thermostat on the associated pump detects a significant temperature rise. LH lamp connected to No.1 System Aux pump thermostat, RH lamp to No.2 System. Either lamp remains on until the pump casing temperature falls. Both lamps are connected to the Master Warning system. If either lamp comes on, the associated Aux pump should be switched off; and thereafter used in emergency only. When the Aux pump switch is selected 'Off', the warning lamp is cancelled.

Press each lamp housing to test, pull to isolate from the Master Warning system.

AUX PUMP switches (2), on hydraulic control panel, up 'On', down 'Off'. When either switch is selected 'On', the associated Aux pump is energised to provide main system pressure controlled to 3,000 psi. Either pump can draw fluid from its associated reservoir by pump suction, in the event of loss of reservoir air pressure: the No. 1 system pump via a sump at the bottom, No. 2 system pump via a stackpipe in the reservoir (to maintain an emergency reserve for flap lowering by the DC pump) or from the emergency reservoir.

Gate valves in the supply lines to No. 2 Aux pump control the pump supply and are operated by the No. 2 Aux pump switch and the emergency elevator selector.

With the pump switch selected On, and the Elevator Emerg selector 'Off', the supply is from the system reservoir and the line from the Emergency reservoir shut off; when the Elevator Emerg selector is selected 'Emergency', the valve positions are reversed, the supply from the system reservoir shut off, and the pump supplied from the emergency reservoir.

ENGINE PUMP switches (2), on hydraulic control panel, up 'On', down 'Off'. When either switch is selected 'Off', the associated engine-driven pump off-load solenoid is energised, and the EDP maintains an off-stroke condition in which a low flow of fluid is allowed through the pump to the reservoir return line at 300 psi to provide pump lubrication and cooling. When either switch is selected 'On', the associated EDP off-load solenoid is de-energised, and the EDP reverts to automatic operation to generate system pressure and control it to a nominal 3,000 psi, off and on - stroking to maintain that pressure against systems operation and normal system leakage.

PRESSURE FAIL WARN lamps (4), amber, on hydraulic control panel. Connected to pressure switches on the delivery line from each EDP and Aux pump. Left outer No.1 EDP, left inner No.1 Aux pump, right inner No.2 Aux pump, right outer No.2 EDP. On when the associated pump delivery pressure falls through 1,500 psi.

The outer lamps are also connected to pressure switches in the pressurising air supply lines to the system reservoirs, and come on if the air pressure falls through 8 psi.

The outer lamps go out as the hydraulic pressure rises above 1,500 psi and the reservoir air pressure rises above 8 psi.

The inner lamps will go out when the hydraulic pressure exceeds 1,500 psi, irrespective of the reservoir air pressure.

Each lamp is connected to the Master Warning system. Press to test, pull to cancel the Master Warning.

Each inner lamp is isolated when the associated Aux pump switch is selected Off.

DC PUMP switch (1), on hydraulic control panel. Centre 'Off', up 'Brake Acc'. down 'Emerg Flap'; spring biased 'Brake Acc' to 'Off'. When selected 'Brake Acc', the DC pump is energised to charge the brake accumulators and provide hydraulic power for the port windscreen wiper and airstair systems; an electrical circuit is also completed to the brake accumulator pressure gauge, and the flap emergency selector valve is de-energised.

When selected 'Flap Emerg', the DC pump is energised and the flap emergency selector valve diverts pump output into the No.2 flap motor of the flap drive unit via a shuttle valve - see Flying Controls.

With the switch selected 'Off', the DC pump is energised when the No.2 system pressure is less than 1,500 psi and the airstair controls are operated.

POWER VALVE magnetic indicators (2)
SPOILER FAIL WARN lamps (2)
OUTER SPOILER switch (1)
INNER SPOILER switch (1)
GUST DAMPER ENGAGED indicator lamps (1)
FEEL FAIL WARN lamp (1)

- See Flying Controls section.

HYDRAULIC POWER - GROUND SERVICING

RESERVOIR SIGHT GLASSES (2), one on each system reservoir in the main undercarriage bay. Maximum and minimum fluid levels are indicated by markings on the adjacent instruction label.

Reservoir Capacities:

No.1 System - 22 pints.

No.2 System - 30 pints (including emerg reservoir).

GROUND SERVICING PANELS (2), one on each side of fuselage behind main undercarriage bay; access via hinged door. Units on each panel comprise:

PUMP BYPASS AND PRESSURE PRIMING coupling (1). Used for normal system replenishment, using a fluid charging rig.

PUMP DELIVERY PRESSURE coupling (1)) Ground test rig connections
PUMP INLET SUCTION coupling (1))

RESERVOIR DRAIN coupling (1)

RESERVOIR AIR CHARGING valve (1). Used for repressurising the system reservoir after replenishing or ground servicing.

ACCUMULATOR AIR CHARGING valve (1)

ACCUMULATOR AIR PRESSURE gauge (1)

RESERVOIR AIR PRESSURE gauge (1)

BRAKE SYSTEM ACCUMULATORS CHARGING panel (1), on bulkhead fwd of centre section torque box. Access via hinged panel in port bottom fairing. Comprises:

ACCUMULATOR AIR CHARGING valve (1)
ACCUMULATOR AIR PRESSURE gauge (1)

STANDBY STEERING ACCUMULATOR CHARGING panel (1), in nosewheel bay. Access via panel in fwd nosewheel door. Comprises:

ACCUMULATOR AIR CHARGING valve (1)
ACCUMULATOR AIR PRESSURE gauge (1)

BRAKE SERVO SYSTEM RESERVOIR (1), on fwd face of nose pressure bulkhead. To gain access, hinge up radome. Fitted with filler cap.

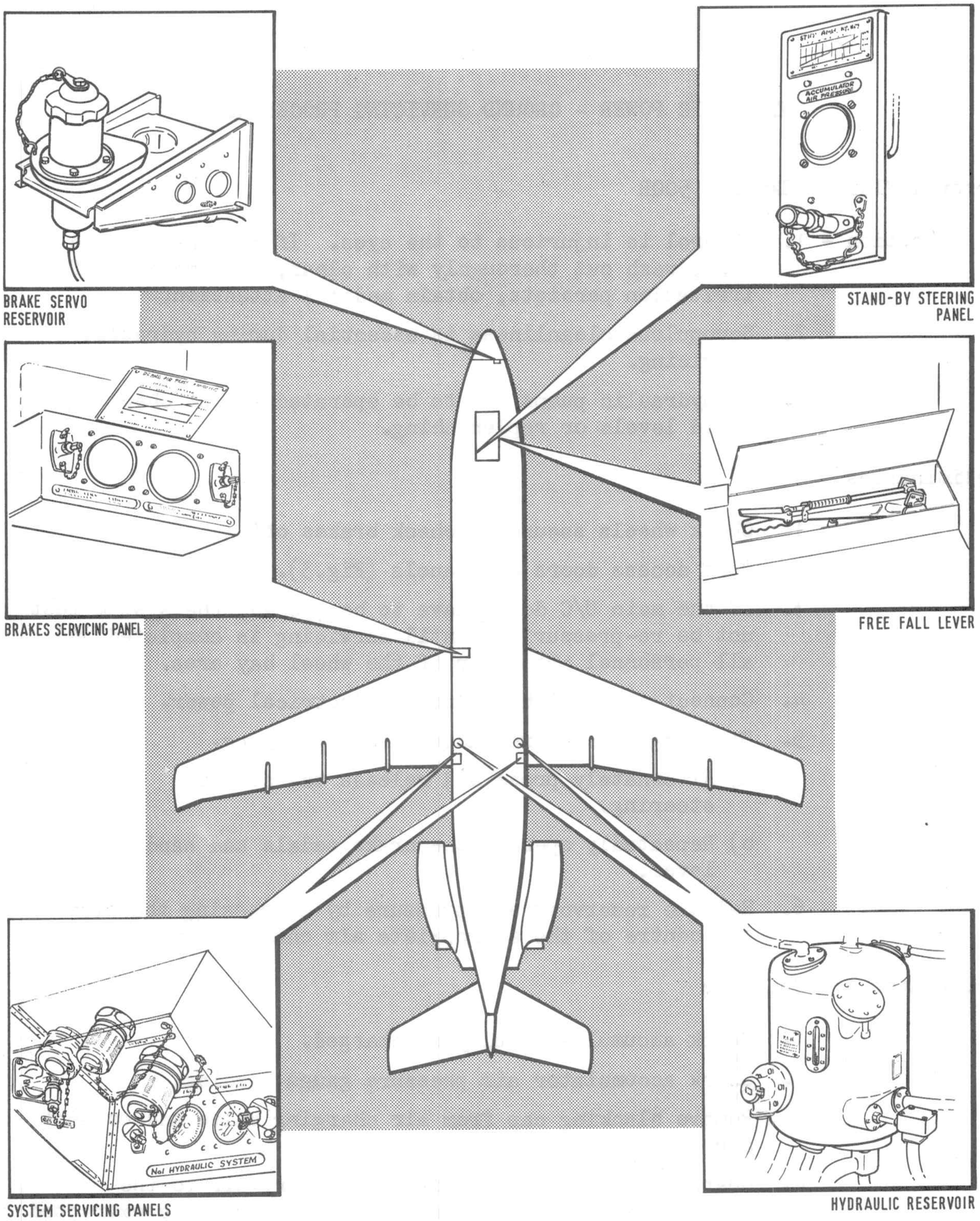


FIG. 2 GROUND SERVICING POINTS

HYDRAULIC POWER - GROUND SERVICING PROCEDURES

Approved fluid - Skydrol 500B

Caution - 1. Skydrol is injurious to the eyes. If splashed in the eyes, wash out thoroughly with clear, cold water. If irritation persists, obtain medical attention.

2. Scrupulous cleanliness is essential during hydraulic servicing.

3. No hydraulic pumps are to be operated whilst checking fluid levels or replenishing.

Preliminaries

1. Chock wheels securely, check brakes off.
2. Open access doors and panels (Fig.3).
3. If the main U/C doors have to be opened, the system must not be re-pressurised until servicing is completed and all personnel are clear of the wheel bay area.
4. Connect and switch on ground electrical power.
5. Discharge all stored accumulator pressure.
   - a) Alternately press and release the standby steering.
   - b) Repeatedly operate the brake pedals and handbrake lever.
6. Release reservoir air pressure by depressing the stem in the centre of the appropriate air charging valve.

Accumulator Air Charging

1. Check accumulator fully discharged.
2. Check accumulator air pressure gauge reading.
3. Remove blanking cap from air charging valve and connect air line.
4. Charge the accumulator with clean, dry air to the appropriate pressure below, or to the pressure extracted from the adjacent temperature/pressure graph for the ambient temperature.

NOTE: When the stand-by steering accumulator requires charging, the nose U/C ground lock must be fitted before the system reservoir is charged.

5. Disconnect air line, replace blanking cap on charging valve, check indicated gauge pressure correct, replace access panel and secure.

Nos. 1 and 2 System accumulators	- 2,000 psi
Brake System accumulators	- 1,000 psi
Standby Steering System accumulator	- 1,500 psi

Main Reservoir Replenishing

Ground Servicing Unit Available:

1. Preliminaries completed.
2. Remove cap from Pump bypass and pressure priming coupling, connect servicing unit hose.
3. Check all accumulator air pressures correct.
4. Replenish to 'Max' level of sight glass.
5. Disconnect hose, replace cap.
6. Charge reservoir with air - see Air Charging.
7. Start both AC pumps.
8. Operate each Flying Control system in turn.
9. Check System Quantity gauge pointers register at top of green sector.

Brake Servo System Reservoir Replenishing

1. Chock main wheels securely, check brakes Off.
2. Release radome and prop open.
3. Remove filler cap, and replenish until fluid level is ½ in from top of reservoir.
4. Replace filler cap.
5. Operate port and starboard brake pedals individually and in pairs.
6. Re-check fluid level, if necessary top up.
7. Close and secure radome.

Reservoir Air Charging

1. Remove blanking cap from Reservoir air charging valve on appropriate Ground Servicing panel, and connect air line.
2. Charge the reservoir to 38 psi on the Reservoir Air Pressure gauge with clean, dry air.
3. Disconnect air line, replace blanking cap.

Servicing Completed

1. Check all ground servicing equipment withdrawn, clear.
2. Check all access panels, caps for security.
3. Complete Technical Log entry.

UNDERCARRIAGE RETRACTION/LOWERING

UNDERCARRIAGE SELECTOR lever (1)
LATCH RELEASE knob (1)
LOCK OVERRIDE lever (1). On centre instrument panel. The selector lever moves vertically in a gated quadrant, 'Up' and 'Down', and is held in the selected position by a spring-loaded latch; to make a selection, the latch is disengaged by pulling the black release knob forming the head of the selector lever. Lever movement is transmitted by cables to the undercarriage control valve. With the main undercarriage legs compressed by the weight of the aircraft, the selector lever is locked in the Down position by a safety lever operated by a lock solenoid: the solenoid is de-energised, allowing a roller on the selector lever shaft to engage on a detent on the safety lever. On aircraft post mod 32A301, a microswitch in the circuit to the U/C Unlocked warning lamp is operated by the latch to give warning of an un-latched condition.

The main undercarriage legs retract inward, the nose under-carriage forward: the unpressurised wheel bays are sealed by mechanically-linked (nose and outer main bays) or hydraulically-operated (main inner bay) doors, and additional small, fixed doors are mounted on the main undercarriage legs. The main bay doors and the two forward nose bay doors are closed when the undercarriage is selected and locked Up, or down, being opened during the raising and lowering only. No.1 System pressure is used for undercarriage raising and lowering.

The nosewheels are self-centring, a centring valve ensuring that 'raise' line pressure cannot be relayed to the nose undercarriage lock and retraction jacks unless the nosewheels are centred. During retraction, the nosewheels engage guide and spin brake ramps to maintain the centred condition and stop wheel rotation. The nose undercarriage is geometrically locked up or down by a hydraulic lock jack. Rudder Fine steering is disconnected by nosewheel oleo extension during rotation, and normal steering system depressurised by U/C Up selection.

At the commencement of retraction, the main wheel brakes are applied by Hand brake system pressure from the 'Raise' line operating the auto-brake system; when retraction is complete, the main undercarriage legs are held up by locked hydraulic fluid. As each main leg extends fully during lowering, the spring-loaded Down lock is mechanically engaged.

/Cont'd. ...

With the undercarriage fully locked up, the undercarriage operating system is opened to No.1 System return lines, and maintained in the de-pressurised condition as long as the selector lever is left in the Up position.

If the gear lock solenoid is not energised when the aircraft becomes airborne, and the safety lever detent remains in engagement with the selector lever roller, the selector lever can be released manually by pressing down the lock-override lever mounted immediately below the selector lever arm.

FREE FALL lever (1), below a hinged cover on flight deck floor, adjacent to stbd console. Raise cover, pull lever up and lock in the operated condition to lower the undercarriage in the event of normal operating system or No.1 Hydraulic System failure. Regardless of the setting of the control valve, the pressure supply to that valve is shut-off, and both the 'raise' and the 'lower' lines opened to reservoir return. The Relay and Lock valve is opened to release trapped hydraulic fluid in the line to each retraction jack. The nose undercarriage lock and the main undercarriage bay door locks are released.

Each undercarriage leg falls under its own weight, opening the bay doors by direct contact or the operating linkage as appropriate. The spring-loaded nose undercarriage lock and main undercarriage down lock re-engage as each leg reaches the 'fully down' position. The main undercarriage bay inner door remain open.

U/C UNLOCKED warning lamp (1), red, twin-lamp unit on centre instrument panel. On when any leg is not locked in the selected position, or a nose-wheel bay door or inner main door is unlocked. On aircraft post mod 32A301, on when the U/C selector lever is not latched securely in either gated position.

UNDERCARRIAGE DOWN indicator lamps (3), green, twin-lamp units on centre instrument panel. On when the associated undercarriage legs are locked down.

DIMMING switch (1), on centre instrument panel immediately beneath U/C position indicator lamps. Up 'Bright', down 'Dim'. Alters intensity of all four indicator lamps.

WARNING horn (1). Sounds (continuous) when any U/C leg is not locked down and either:-

(a) One or both throttle levers are closed below the approach rpm setting, with an IAS of less than 165 kt.

The horn cut-off switch allows the warning to be suppressed: but the circuit is re-armed when the undercarriage is locked down, or both throttles are opened beyond approach power.

Or:-

(b) The flaps are extended beyond 18°. The warning can only be suppressed and cancelled by raising the flaps or locking all U/C legs down.

HORN CUT OFF/TEST switch (1), on centre instrument panel. Up 'Cut Off' to isolate the horn, down 'Test' to complete independent electrical circuit to the warning horn. Spring-loaded from both selections to centre 'Off'.

MAIN U/C MECHANICAL indicators (2), one on each wing upper surface. Green-painted rod extends into raised perspex cover as associated main U/C leg is locked down.

NOSEWHEEL MECHANICAL indicator (1), sight tube under access panel in the floor at the rear of the flight deck. Two superimposed quadrants, each with a hole cut in it, are linked to the nose U/C lock and retraction jacks. The hole in the upper quadrant is covered with a transparent green glass, and a reflector mounted below the lower. With the wheel well light on, and the nose U/C locked down, the holes in the quadrant coincide to allow the reflected light to be seen through the sight tube and green glass; the result should be a full green disc.

NOSEWHEEL STEERING

NOSEWHEEL STEERING HANDWHEELS (2), on port and stbd consoles. Conventional steering wheels connected by cables to the input/feedback linkage of the steering control valve. The system is powered either by No.1 System pressure via the undercarriage steering and lock valve or No.1 System direct via the standby steering selector. The handwheels are interconnected, giving steering up to 78° of offset in either direction. Hydraulic pressure is only available when the nose undercarriage is locked down.

Rudder pedal movement is fed into the steering control system via a hydraulic/mechanical interconnection. Rudder Fine steering is limited to a nosewheel deflection of 5-7° to either side, corresponding to full rudder travel. The break-out force of the interconnection is low, enabling independent control of rudder and nosewheel steering to be easily gained. Nosewheel position indication is given by a white mark on each wheel and three white marks on the handwheel mountings.

The response of the steering system to handwheel movement is virtually instantaneous, with pressure available handwheel position coincides with nosewheel offset. When either handwheel is moved the nosewheels will be maintained at the selected deflection by hydraulic locking of the steering jacks; if the handwheel is released, the nosewheels will be steered back to centre, and the handwheel will rotate back to the central position. With the wheels and rudder bars free to move, free castoring is available within the deflection range of the rudder fine steering system, the controls moving in accordance with the nosewheels.

STANDBY STEERING switch (1), on port console. Guarded, caged in the down 'Off' position, hinge back cage to select up 'On'. When selected on, completes a circuit from the weight switches on the main undercarriage legs to the solenoid of the standby steering selector valve.

When the weight switches are operated, as the undercarriage legs support the aircraft's weight, and with the standby steering switch selected 'On', No.1 System pressure is supplied via a shuttle valve to the steering control valve. In the event of No.1 System failure, fluid stored, at 3,000 psi is available in the standby accumulator for nosewheel steering, providing steering movements totalling 220° approx.

LOW PRESS warning lamp (1), amber, press-to-test, on port console. On when the standby steering accumulator pressure falls to 2,000 psi.

WHEEL BRAKES

ACCUMULATOR PRESSURE gauge (1), on centre instrument panel. Dual pointer instrument, scales calibrated 0-4,000 psi in 1,000 psi divisions; LH pointer - foot brake accumulator pressure, RH pointer - hand brake accumulator pressure. Brake system pressure is supplied by No. 2 System; in the event of failure of No. 2 System, the accumulators store sufficient pressure for:

Foot brakes - One complete braked landing, with the anti-skid units operating.

Hand brakes - Minimum of six full brake applications.

BRAKE TOE PEDALS (4), one attached to each rudder pedal. Pedal movement is transmitted by a hydraulic servo system, from the left pedal of each pair to the port brakes control valve, from the right pedals to the stbd brakes control valve, to direct pressure to the port and starboard brake units via shuttle valves up to a maximum of 3,000 psi. With the anti-skid system operating, the applied brake pressure can be automatically reduced by each dual pressure control valve, these valves also acting as pressure relief valves for the lines to the individual brake units.

ANTI-SKID selector switch, on centre instrument sub-panel. When selected up 'On', the anti-skid system monitors wheel deceleration rate for each main wheel. Information from a transducer within each wheel axle provides a continuous electrical signal, proportional to wheel rotation velocity, to the controller unit. As the applied brake pressure at each wheel approaches the maximum consistent with runway condition, the controller unit detects the onset of skid by the increase of the wheel deceleration rate above a pre-set limit, and reduces the applied brake pressure to the affected wheel by actuating one dual pressure control valve until the wheel has spun-up to a normal speed.

The Anti-skid system additionally provides:

Locked wheel protection - if one wheel stops turning whilst the corresponding wheel on the other undercarriage leg is rotating, rate brake pressure to that wheel is completely released. This facility is cancelled below 15 kt.

On touchdown, brake pressure is isolated from the wheel brake units until weight switches on the main undercarriage legs have operated, and the wheels have spun-up.

When selected down 'Off' the main brakes revert to direct operation, with no pressure relief in the event of a wheel failing to spin up on touchdown or the onset of skidding is reached.

ANTI-SKID TEST switch (1) on centre instrument sub-panel. Spring-loaded to centre 'Off' position. When held up, 'Inner Test', or down 'Outer Test', applies simulated wheels rotating transducer signals from the appropriate wheels to the control unit. Switch operation during brake application would cause loss of braking for 1-2 secs.

If external confirmation of correct system operation is required, the brakes should be applied during the check.

ANTI-SKID indicators (4), on centre instrument sub-panel, one for each wheel brake unit. Illuminated to show REL when brake pressure is released by the dual pressure control valve, blank when wheel brake pressure is being controlled by pedal application alone, only during testing.

With the undercarriage down and foot brakes on, test switch selection gives the following indications:

1. Hold to 'Inner' - all Blank.
2. Release - Inner to 'Rel', then Blank.
3. Hold to 'Outer' - all Blank.
4. Release - Outer to 'Rel', then Blank.

FOOT BRAKE PRESSURE gauge (1), on centre instrument panel. Duel pointer instrument, showing brake pressures applied by the port and starboard brake control valves to the respective dual control valves, scales calibrated 0-4,000 psi in 1,000 psi divisions.

HAND BRAKE levers (2), one on either side of the centre console. As either lever is pulled up, the movement is transmitted by cable to the hand brake control valve, and brake pressure is directed equally to all four brake units via the shuttle valves. 'Feel' is given by springs, the applied pressure proportional to the amount of lever movement up to a maximum of 2,000 psi. The hand brake control valve is also operated by the auto-brake jack to give a brake application of 1,000-1,800 psi (400-600 psi post mod 32A487) during undercarriage retraction.

The port (Captain's) lever can be locked in the Parked position by pulling fully up and turning the handle 90°.

Auto-brake application during undercarriage retraction is indicated on the hand brake pressure gauge: should the auto-brake jack fail to release, pull the hand brake lever out fully and return to free the brakes.

HAND BRAKE PRESSURE gauge (1), on centre instrument panel. Single pointer, scale calibrated 0-4,000 psi in 50 psi divisions. Shows hand brake pressure applied to the wheel brake units.

BRAKE TEMPERATURE gauges (2), on stbd console. Dual pointer instruments, scales graduated 0-800°C in 100° divisions. LH gauge shows port outer and inner brake unit temperatures, RH gauge stbd inner and outer temperatures.

Following a sustained brake application, eg - during landing or abandoned take-off, the gauges will under-read for approx. 3-5 minutes, after which time the temperature indications will be accurate with or without the brakes being applied.

DC PUMP switch (1), on stbd roof panel. When selected 'Brake Acc', the DC pump is energised to provide hydraulic power for the operation of brakes, ventral air steps and port windscreen wiper, or for emergency flap lowering; the switch is spring loaded from 'Brake Acc' to centre 'Off'. The DC pump is also energised to provide the above service when the ventral air steps controls are operated, even if the pump switch is selected Off. When selected 'Flap Emerg', the emergency flap selector valve is electrically actuated to shut off the line from the DC pump to the normal services above, and to direct pump pressure to the flaps drive unit until the switch is manually returned to the Off position - See also 'Flying Controls' section.

UNDERCARRIAGE - GROUND SERVICING

BRAKES AND TYRES. See 'Hydraulic Services', - Vol 1, Flight Management for tyre pressures, limitations, cooling periods, and inspections.

HYDRAULIC SYSTEM (including accumulators). See 'Hydraulics' - Ground Servicing.

TYRE INFLATION VALVES (6) one for each tyre. Permits inflation to the correct pressure with nitrogen or dry air.

OLEO AIR AND FLUID CHARGING. See Maintenance Manual Ch 29.

BRAKE WEAR indicator pins (4), one on each wheel hub. Protruding pin, retreating into housing as brakes wear. When head of pin is flush with housing, brake pads require replacing.

PRIMARY FLYING CONTROLS

AILERON HANDWHEELS
ELEVATOR CONTROL COLUMNS
RUDDER PEDALS. Dual controls, movement of which is transmitted by cable runs and rods to the elevator and rudder control jacks, and to the aileron spring/servo tabs. The elevators are individually moved by tandem jacks, powered by Nos.1 and 2 Systems, the ailerons by the aerodynamic forces produced by servo tab deflection. Aileron control is normally assisted by differential extension of the speed brakes on each outer wing.

Ailerons

The aileron handwheels are interconnected, and each connected by a cable run to one aileron servo tab. The ailerons are interconnected by cable to prevent excessive up-float, provide an alternate control path to aileron affected by failure of its control cable run or linkage, and ensure symmetric aileron movement.

The servo tabs are hinged to the ailerons, connected directly to the control input cable run and by torsion bars to the wing (stbd side) or to the trim jack on the wing structure (port side). The torsion nars oppose movement of the servo tabs, to provide additional feel and self-centring.

A cross shaft interconnects the operating pulleys moved by the handwheels, and is also connected to the auto-pilot servo drive. Quadrant pulleys in each control cable run feed aileron demands to the spoiler mixing units. Aileron gust dampers, hydraulic dash-pots, protect the system against damage from gusts whilst on the ground, by providing a resistance proportional to the rate of control surface deflection; in flight this applied resistance is negligable, in comparison with the leverage produced by the servo tabs. If the ailerons are fully deflected, the transfer rate of the fluid between chambers is further restricted, and a steady force of up to 120 lb applied for several seconds may be required to move the ailerons toward centre whilst on the ground; the required force may be greater if the aircraft has been standing for some time in strong sunlight and the units become heated.

Elevators

Movement of the interconnected control columns is transmitted by twin cable runs and connecting linkage to the control valves of the tandem jack which drive the elevator: each elevator surface is moved by its own jack, assisted by the deflection of a geared tab, and each jack section is supplied individually from a separate hydraulic power system.

With one or both hydraulic power system pressures available, control movement opens both rotary valves on each tandem jack; resulting movement of the jack body along the fixed piston is transmitted to the elevator, and progressively restores the rotary valves to the neutral (locked) position. If one hydraulic system fails or is isolated, the affected section of each jack freewheels. If one rotary valve seizes or its input linkage fails, the jack will be moved by the remaining section, collapsing a spring strut in the operating linkage; this operates a micro switch, closing an isolate valve to cut off hydraulic pressure to the failed section, and switching on the Servo Fail warn lamp in the head of the associated Hydraulic Cut-Off Lever.

The autopilot elevator servo drive is connected to the stbd control run. Stick shaker, stick pusher, and elevator feel units are incorporated in the control system. When weight switches on the undercarriage legs are operated by the aircraft's weight, and system No.1 depressurised, tandem jack valves of No.1 System both revert to a 'gust damping' mode, and bring on the Gust Damper Engaged lamp.

Rudder

Rudder control is effected by a system similar to that operating the elevators, except that rudder pedal movement is transmitted to and operates two single hydraulic jacks, the lower powered by No.1 System, the upper by No.2. The autopilot servo motor is connected to the input cable run.

With both hydraulic systems depressurised, the rudder jacks operate automatically in the gust damping mode.

In the event of failure or isolation of both hydraulic systems, full manual reversion is available; but control loading is high, with lag caused by lost motion in the control linkage.

Rudder/Elevator Feel

Elevator and rudder feel is provided by feel units. Each feel unit comprises two hydraulic jacks controlled by pitot/static pressure, and an equalising linkage connecting the jack rams to the control cable runs; the equalising linkage maintains the feel rate in the event of one jack loasing its operating pressure, and varies its mechanical advantage with control deflection. With the aircraft on the ground, the jack pressures are controlled to give a resistance to movement equivalent to an indicated airspeed of 110 kt, and to give control centring. As airspeed increases above 110 kt the jack pressures are progressively increased, imparting increasing resistance to ram movement and consequently control deflection up to a maximum equivalent to 330 kt IAS.

The Elevator feel unit additionally comprises a third hydraulic jack powered by the Emergency Elevator system, providing a fixed feel equivalent to 180 kt IAS.

FEEL FAIL warning lamp (1), amber, on hydraulics panel. On when either hydraulic jack in the rudder feel unit moves abnormally in relation to the other jack. Connected to the Amber MWS. Press-to-test, pull to cancel.

SERVO FAIL warning lamps (2), red, on the head of each hydraulic cut-off lever (see below). On when any of the micro switches, mounted on the spring struts connecting the control input to the control valves of the rudder and elevator jacks and the TPI and Flap hydraulic motors, are operated by collapse of a strut in the event of control valve seizure. With the exception of the control valves for the Flap motor, which have to be isolated by shutting the appropriate Hydraulic cut-off valve, the affected control valve is automatically isolated, as the warning signal actuates an isolate valve to shut off system pressure to that jack or jack section; the isolated unit will now 'free-wheel', and the control surface moved by the remaining unit powered by the unaffected hydraulic system.

Each lamp is connected to the Master Warning system. If the lamp comes on, the parent lever must be moved to the aft 'off' position, cutting off hydraulic system pressure to the rudder jack, elevator jack sections, flaps motor, TPI drive motor, feel unit jacks, and spoiler jacks (inner or outer) supplied by that system. The lamp goes out, and the Master Warning is cancelled.

TEST switch (1), push-button type, on centre console. When pressed, completes a test circuit through the Servo Fail warning lamps on the hydraulic cut-off levers, provided the levers are at the 'Off' position; if either lever is in the 'On' position, the associated warning lamp should not come on when the switch is operated. On aircraft post mod 27A245, this switch incorporates a green Emerg Elev Selected lamp.

HYDRAULIC CUT-OFF levers (2), on centre console. Fwd 'On', aft 'Off', controlling the servo power valves of Nos.1 and 2 hydraulic power systems. When selected 'Off', depressurises the flight control hydraulic jacks and motors supplied by that hydraulic power system, port lever - No.1 System, stbd - No.2.

RUDDER PEDAL adjusters (2), one on each side console. Pull to release the associated set of rudder pedals for reach adjustment.

AILERON TRIM knob (1), on centre console. Turn anti-clockwise 'Lower port wing', clockwise 'Lower stbd wing', scale graduated 0-10 divisions to either side of 12 o'clock - neutral. Connected by cable run and quadrant pulley to the trim jack. Rotation of the knob winds up the torsion bar connected to the port aileron servo tab, to produce a spring loading against the servo tab; if the aileron hand wheel is held, this loading is felt as a wing-heavy reaction; when the handwheel is released, the servo tab is deflected until the ailerons have moved to the new trimmed neutral position.

RUDDER TRIM knob (1), on centre console. Turn left 'Nose port', turn right 'Nose stbd'. Scale graduated 0-10 divisions to either side of 12 o'clock - neutral. Connected by cable run to feel simulator linkage; when the knob is turned, the neutral point of the linkage is displaced, causing the pressure exerted by the feel jacks to drive the linkage to the rudder jack control valves until the rudder reaches the new trimmed position.

TAIL TRIM handwheels (2), on either side of centre console, inter-connected. Rotate fwd 'Nose down', aft 'Nose Up'. Concentric scales graduated U1-U10, neutral - white arrow head, 1D-2D, registering against white mark on each wheel mounting to show selected tailplane incidence; permitted take-off range indicated by white band.

The hand wheels are connected by a clutch to a cable run terminating at the selector valves of two hydraulic motors in the TPI drive unit; each motor is powered by a different hydraulic system via servo cut-off valves and individual isolate valves.

Handwheel rotation moves both selector valves, to energise both hydraulic motors, releasing their hydraulic locks, and initiating movements of the tailplane in the desired direction. A follow-up linkage restores the selector valves to the neutral position as the tailplane reaches the selected incidence, and the motors are hydraulically locked against further motion. If one hydraulic system fails, or the motor is isolated, the affected motor is free to rotate; if both systems fail or both motors are isolated, the tailplane drive screw is braked to prevent further movement.

In the event of selector valve failure, the spring strut connecting that valve to the cable run is collapsed, operating the isolate valve, removing the hydraulic lock on that motor, and switching on the Servo Fail warning lamp on the Hydraulic Cut-Off lever.

TAILPLANE INCIDENCE position indicator (1), on centre instrument panel. Electrically actuated by transmitter on tailplane, indicating achieved setting of tailplane. Graduated 0-11 divisions Nose Up, 0-2 divisions Nose Down. White sector shows permitted take-off range.

ELEVATOR TRIM selector switches (2) on centre console. Caged, spring loaded to centre 'Off', held fwd 'Nose Down', aft 'Nose Up'.

Holding both switches fwd or aft energises an electric motor to move a trim tab on the port elevator. This system may only be used when normal trimming by tailplane incidence is inoperative and the flying controls are being operated by manual reversion.

ELEVATOR TRIM TAB position indicator (1), on centre instrument panel, graduated in divisions of Nose Up or Down trim. Electrically indicating setting of port elevator trim tab.

ELEVATOR GUST DAMPER ENGAGED lamp (1), on hydraulics control panel, green. On when the No.1 System sections of the elevator tandem jacks revert to the gust damping mode following depressurisation of that hydraulic system on the ground.

ELEVATOR EMERGENCY selector switch (1), on centre console. Guarded, fwd 'Off', aft 'Emerg'.

In the event of failures causing the loss of hydraulic power to both flying control systems by closure of both hydraulic cut-off levers, the elevators can be powered by the emergency system.

Selecting 'Emerg' reverses the positions of the two valves in the supply lines to No.2 Aux pump, to shut off the line from the main reservoir and open the line from the No.2 emergency reservoir, energises the No.2 Aux pump, and energises the Emerg selector valve which opens a line to the No.2 system sections of the elevator tandem jacks via a shuttle valve. Return fluid from the elevator jack sections now powered is directed into a return line to the emergency reservoir. No.2 Aux pump pressure is also supplied to the emergency feel jack in the elevator feel unit, to provide a constant feel equivalent to an IAS of 180 kt.

When the switch is at Emerg, the Emerg Elev Selected lamp will be on (A/C post mod 27A245).

ELEVATOR EMERGENCY LP warning lamp (1), amber, on centre console. On when hydraulic pressure in the emergency elevator system falls below 1,500 psi with the Elevator Emergency selector switch selected 'Emerg'. Connected to Master warning system, press-to-test.

EMERG ELEVATOR SELECTED lamp (1), post mod 27A245, on servo fail lamp test switch (centre console), Green. Comes on when the emergency elevator system is selected.

ELEVATOR EMERGENCY FAIL lamp (1), red, on centre console. On when seizure of the control valve for the section of either elevator tandem jack powered by No.2 system collapses the spring strut, with the Elevator Emergency selector switch selected 'Emerg', and energises the Emergency Selector valve to isolate and depressurise the emergency system; the Aux pump should be switched off by selecting the Elevator Emergency selector switch 'off'. Connected to the Master Warning system, press-to-test.

SERVO POWER VALVE magnetic indicators (2), on hydraulics panel. Display in-line indication - associated valve open, cross-line - associated valve shut.

FLAPS

FLAP SELECTOR lever (1), on centre console, moving in quadrant engraved fwd 'Up', through '8°', '18°', '26°', to fully aft '45°'. A cable run connects the selector lever to the linkage actuating the two flap motor control valves. Each flap motor is powered by a separate system, the flap motor powered by No.2 System can be operated in emergency by No.2 DC pump drawing fluid from the sump of No.2 System reservoir.

With the control valves in the neutral position, the motors are hydraulically locked. When the selector lever is moved, the control valves are opened and both motors rotate the primary flap drive shaft; this rotation is transmitted by bevel gears to the screw jacks moving the flap sections, and to the follow-up system. As the flaps reach the selected position, the follow-up system returns both control valves to neutral, and the hydraulic lock in each motor is restored. Special care must be taken to ensure that the selector lever is properly gated when making an Up selection.

Each control valve linkage incorporates a spring strut; if the control valve seizes, the spring strut is collapsed and operates a micro switch to illuminate that system Servo Fail warning lamp and arm the Master Warning system. When the appropriate Hydraulic Cut-Off Lever is pulled fully aft, the warning lamps are cancelled, the failed motor is able to rotate freely once system pressure is dissipated, and the remaining hydraulic motor will continue to operate the flaps at a reduced rate. If both motors lose hydraulic pressure, the primary flap drive shaft is automatically braked to prevent further flap movement, and further flap selections are only available via the emergency system.

Following failure of both hydraulic power systems, selecting the DC Pump switch to 'Emerg Flap' will energise the motorised emergency flap selector valve to open a line from the DC pump via a shuttle valve to the No.2 System hydraulic motor, and switch on the DC pump. A selection of 18° flap from 'Up', using this system,can be made using the flap selector lever normally; it will take 4-4½ minutes to achieve this setting. This system must not be used to attempt a selection greater than 18°, as the DC pump is only rated for 5 min continuous operation and the rate of flap travel is very low.

FLAPS POSITION indicator (1), on centre instrument panel. Scale marked '0°', '3°', '8°', '18°', '26°', '45°', with white rectangles. In addition to the flaps position indicator, there are incidence markings on the port and stbd centre flaps, showing 0°, 8°, 18°, 26°, and 45° when the appropriate marks are aligned with the main-plane trailing edge.

FLAP SHAFT FAIL warning lamp (1), amber, on centre instrument panel. Press to test. If either primary transmission shaft fails, a secondary transmission shaft on that failed side will engage the flaps drive screw jacks. The secondary transmission system normally lags fractionally behind the primary transmission, maintaining separation of clutch dogs; and as this lag is taken up, the dogs engage to drive the flap sections, and a microswitch is operated to illuminate the warning lamp.

SPOILERS AND LIFT DUMP

SPEED BRAKE lever (1), on centre console, moving in quadrant engraved '0°', '10°', '20°'. '30°', '40°', and '50° Lift Dump' from fully fwd to fully aft. The quadrant is gated at the '20°' position, and to achieve a selection greater than 20° a lever latch has to be withdrawn by pulling up the sliding handle of the lever from the 'Above FL150' position to the 'Below FL150' position. The lever is connected by a cable run to the port and stbd mixing units, and by a lever to the lift dump control valve; each mixing unit also receives inputs from the aileron control cable run, and is connected by rods and spring struts to the control valves of the two jacks operating the two speed brake surfaces on that outer wing. The outer jacks are supplied by No.1 System, the inner by No.2 System.

With the ailerons in the neutral position, a speed brake selection opens all four jack control valves; the jacks extend the speed brake surfaces until the feed-back linkage between each surface and the associated jack control valve closes the control valve when the selected angle is achieved.

With the speed brakes extended, movement of the aileron handwheel is transmitted to the mixing units, mechanically combining the speed brake and aileron inputs, to produce asymmetric extension of the port and stbd sections. With the speed brakes retracted, aileron control movements will progressively extend both sections on the down-going wing.

Lift dump surfaces, one on each inner wing, are extended by hydraulic jacks powered by No.1 System pressure. When the speed brakes are selected to the '50° Lift Dump' position, the lift dump selector valve in the hydraulic power line is opened, provided both throttles are closed, and compression of both main oleo legs has operated micro-switches, and hydraulic pressure is admitted to the lift dump jacks to extend both surfaces. The lift dumper surfaces retract when the speed brake lever is moved fwd from the 50° position. If No.1 System pressure is lost, the outer pair of speed brake surfaces and the lift dump system will be inoperative; if No.2 System fails, the inner pair of speed brake surfaces will be inoperative. Seizure of a speed brake jack control valve collapses the spring strut connecting the control valve to the input linkage. When either hydraulic system is isolated or depressurised, the affected pair of spoiler surfaces will, if extended, be blown back; if the spoilers are extended beyond 20° at too high an airspeed, they will be blown back to less than the selected position.

SPOILER FAIL WARN lamps (2), on hydraulics panel, amber, press-to-test. On when collapse of the spring strut connecting one of the spoiler jack control valves supplied by the associated hydraulic system operates the microswitch attached to that box. The port, No.1 System lamp indicates failure of an outer jack, the stbd, No.2 System lamp an inner jack. Connected to Master warning system. If either lamp comes on, the appropriate spoiler isolate switch should be selected 'Off'.

SPOILER ISOLATE switches (2), on hydraulics panel. Up 'On', down 'Off'. When selected Off, energises the appropriate isolate valve in the hydraulic power line to the outer (No.1 System) or inner (No.2 System) speed brakes jacks, to cut off the hydraulic power to that pair of jacks; the associated Spoiler Fail warning is cancelled.

LIFT DUMPER magnetic indicators (2), on centre instrument panel, one for each surface. Indicate:

PWR OFF - No electrical power
Blank - Electrical power available, surface retracted
OUT - Lift dump surface extended.

STALL WARNING AND RECOGNITION

PITOT HEATER switches (4), on roof panel. Prime function - see 'Ice & Rain Protection'.

Two switches marked 'Q' additionally control electrical heating elements in the fwd pair of incidence sensors on the fwd fuselage sides, two marked 'Port' and 'Stbd' controlling elements in the rear pair of sensors; the fwd pair of sensors control the Stall Rec systems, the rear pair the Auto-Ignition and Stall Warning systems.

HEATER FAIL warning lamps (4), on roof panel, one for each incidence sensor element. Amber, press to test, turn to dim. On when the associated heating element circuit is broken.

IGNITER ON indicator lamps (4), on roof panel. Prime function - see 'Engines'.

Rotation of the aft pair of incidence sensors, by increasing angle of incidence during stall approach, triggers Nos. 1 and 2 Auto-Ignition systems; No.1 system switches on igniters on both engines and is triggered by the port rear sensor, No.2 a second system of igniters when triggered by the stbd rear sensor.
The angle at which the systems are triggered is reduced by increased rate of change of incidence, and also varied by the setting of the TCC/Fuel Dip switch. Decreasing incidence during stall recovery de-energises both systems when the triggering angle is reached, switching off the engine igniters. The system is isolated when the aircraft is on the ground, by U/C operated switches, but the test facility is available.

AUTO-IGNITION TEST switch (1), on roof panel. Spring-loaded to centre 'Off' position. When pressed up, 'No.1', high energy igniters are energised via No.1 Auto-Ignition system; when held down, 'No.2', No.2 Auto-Ignition system energises the igniters. The Igniter On indicator lamps show system operation.

STALL WARNING TEST switch (1), on roof panel. Spring-loaded to centre 'Off' position. When pressed up, 'No.1', No.1 Stick Shaker system operates; when pressed down, 'No.2', No.2 Stick Shaker system operates.

Under normal conditions, if an approach to the stall is continued after the auto-ignition systems have been triggered, the further movement of the rear incidence sensors will trigger Nos. 1 and 2 Stall Warning systems. No.1 system is connected to the stick shaker unit on the Captain's elevator control column, No.2 to the Second Pilot's. A priority circuit allows the first system triggered to operate it's shaker unit, holding the second triggering signal. Both control columns are vibrated and knocked by the operation of either shaker unit. The systems are isolated when the aircraft is on the ground by U/C operated switches, but the test facility is available.

The angle of incidence at which the stall warning systems are triggered is varied by the rate of change of incidence, lowering the angle if the stall is approached rapidly, and by the selected flap setting.

The stick shaker triggering signal additionally arms the control circuit for the pneumatic valves of the Stick Pusher system. The signals from both Stall Warning systems arm the respective Stall Ident warning horn circuits.

STICK PUSH OP lamps (2), amber, one on each main instrument panel. Press to test. On when the stick pusher ram is pneumatically extended, goes out as the ram is returned to the fully retracted position.

If an approach to the stall is continued after operation of the stick shaker system, further rotation of the forward pair of incidence sensors beyond an angle varied by the rate of change of incidence completes circuits via two independent systems to both warning horns which have been armed by the associated stall warning systems. When the horn circuits are completed, both horns sound, and relay units complete a circuit to two pneumatic valves connected in series; when both valves open, low pressure nitrogen is released into the stick pusher ram. A nose-down initial force of 100 lb is exerted on the control columns via the base of the Captains control column, falling sharply as the control columns are moved forward of the elevator neutral position to 23 lb, and to 5 lb at the fully forward position.

As the aircraft returns to normal flight, the warnings are cancelled, the control valves released to exhaust ram pressure.

The system is isolated on the ground, by weight-operated U/C switches, and for five seconds after take-off by a timing relay.

The test switch is connected via the same oleo-operated relays which isolate the stall warning and recovery system on the ground; the test will function only if these relays are in the 'Ground' condition.

STICK PUSH pressure gauge (1), on stbd console. Dual scales and pointers, L/H scale graduated 0-80 psi with green sector from 50-66 psi, R/H scale graduated 0-2,000 psi with red sector from 0-500 psi. Indicates pressure of nitrogen in the stick pusher system storage cylinder and reservoir. Dry nitrogen is stored in the cylinder (750 litres) at 1,500 psi, sufficient for approx 250 operations of the stick pusher ram; this pressure is reduced to 57 psi to charge the LP reservoir. The HP system incorporates a pressure relief valve and re-charging connection.

STALL REC DUMP valve handle (1), on centre pedestal. Turn and pull out fully to dump LP ram pressure to cabin, isolate the system control valves electrically, cancel the Stick Push Fail warning lamps on the port and stbd instrument panels. The System Fail lamp on the roof panel is switched on. Cannot be reset in flight.

LP WARN lamp (1), red, on roof panel. On when stick pusher system LP reservoir pressure falls to 45 psi. Connected to red Pusher Fail warning lamps. Pull to isolate, press to test.

SYSTEM FAIL warning lamp (1), red, on roof panel. On when any fault is detected in the Stick Pusher system; warning is duplicated by individual Pusher Fail warning lamps. Press to test.

VALVE OPEN warning lamps (2), on roof panel, red. On when the associated Stick Pusher control valve opens. A valve open indication in the absence of a stick pusher triggering signal is a fault indication, bringing on the System Fail warning lamp.

PUSHER FAIL warning lamps (2), red, one on each main instrument panel. On when any system warning lamp on the roof panel comes on.

STICK PUSH test switch (1), on roof panel. Spring loaded to centre 'Off' position. Isolated in flight by the U/C weight switch. With the Stall Warn test switch held in the No.1 or No.2 position, pushing the switch up to the 'No.1' position or down to the 'No.2' position will operate the stick pusher system, extend the ram, and bring on the appropriate system lamps. If both test switches are held in the No.1 or No.2 positions, one warning horn will sound. Releasing the test switch de-energises the system, the Valve Open lamp should go out immediately, but the Stick Push Op lamps will not go out until the ram is fully retracted.

The test switch is connected via the same oleo-operated relays which isolate the stall warning and recovery system on the ground; the test will function only if these relays are in the 'Ground' condition.

TAKE-OFF CONFIGURATION WARNING

WARNING HORN (1). A system of microswitches connected via an interruptor unit to the U/C warning horn produces an intermittent aural warning if, with the aircraft on the ground, either throttle is opened beyond the 9,500 HP rpm setting when:

a) The tailplane incidence is outside the take-off range, or

b) Speed brakes are not selected In, or

c) The flaps are not selected to either Take-Off position.

d) Elevator trim tab is not within ± 1° of neutral.

Continued throttle movement to beyond the 12,000 HP rpm setting isolates the horn. The system is isolated during flight by U/C weight switches.

MACH TRIM SYSTEM

MACH TRIM isolation switch (1) on centre console. Two positions, fwd 'On', aft 'Off'. Normally selected 'On' completing AC power supply circuit to the Mach Trim controller; when selected 'Off' breaks the AC circuit to the controller, de-energising the mach trim actuator and disengaging its clutch.

The mach trim controller is supplied with pitot/static pressure to provide altitude and mach no. information. Command signals are generated by the controller and passed to the mach trim actuator: below 9,600 ± 600 ft and below M_{IND} 0.68 this output is blocked. Provided the altitude is above 9,600 ft approx. an increase of speed above M_{IND} 0.68 will cause the controller to transmit a 'nose-up' signal to the mach trim servo-actuator connected to the tailplane trim circuit via the auto-trim servo unit. Movement of the mach trim actuator is transmitted to the tailplane trim system via an electro-magnetic clutch; this clutch can only be engaged when the auto-pilot is disengaged.

With mach trim engaged, any manual movement of either tailplane trim wheel will result in disengagement of the mach trim actuator clutch by operation of torque switches incorporated in the trim wheels.

MACH TRIM indicator lamp (1), amber, on centre instrument panel. On, pulsing, when AC power is supplied to the actuator; with the clutch engaged or disengaged. Press to test.

FLYING CONTROLS GROUND SERVICING

See 'Hydraulics' section - Ground Servicing.

AIR SUPPLY

FAIL warning lamps (2), amber, on centre roof panel. Connected to the amber master warning system. One for each system, giving warning of a failure resulting in excessive temperature or pressure.

FUSE DUCT FAIL TEST button (1), on centre roof panel. If fuselage overheat thermostats are serviceable, both system Fail warning lamps will light when the button is pressed, and go out when it is released.

ISOL'N VALVE switches (2), on centre roof panel. Up 'Open', down closed. Each switch normally controls both the isolation valve and the pressure reducing valve in its air supply system. When set to 'Open' with air pressure available, the isolation valve opens to permit the supply of HP bleed air from the engine for airframe anticing, air conditioning, pressurisation, toilet flushing and water tank, and the pressure reducing valve maintains a predetermined pressure at the outlet from the main heat exchanger. When at the closed position, the isolation and pressure reducing valves close, and the temperature control valve which regulates the supply of engine HP air to the heat exchanger is also closed to prevent wastage of engine air.

With the associated switch selected to open, the isolation valve and PRV are closed automatically and the system fail and amber master warning lamps come on if:

1. System air pressure or temperature becomes excessive.
2. A stub wing overheat is sensed.
3. An air conditioning overheat is sensed (the appropriate master valve will also close).

The isolation valve is closed automatically, independently of the PRV, by operating the fire control handle of the associated engine.

The PRV operates independently of the isolation valve when:

1. System master valve is selected to 'APU' - PRV closes.
2. Engine Start or Motor cycle is initiated - PRV opens fully.

FAIL PRESS TO RESET buttons (2), on centre roof panel. Used to reset the system and extinguish the Fail lamp after pressing the Stub Duct Fail Test button and after an air system failure.

STUB DUCT FAIL TEST buttons (2), on centre roof panel. If the stub fairing bay overheat thermostats are serviceable the system Fail warning lamp will light when the button is pressed, remaining on when the button is released.

AIR X-FEED VALVE magnetic indicator (1), on centre roof panel. Shows cross-hatch when no electrical supply, 'Open', or 'Closed'.

AIR X-FEED VALVE switch (1), on centre roof panel. Up 'Open', down closed. When at 'Open' a solenoid is energised, allowing air pressure from either side to open the valve, thus interconnecting the two systems. The valve will close automatically in the event of overheating in either air conditioning system.

AIR DEL VALVE switch (1), on centre roof panel. Up 'Open', down closed. Controls the air delivery valve which allows the APU to supply air to No.1 system on reaching 95% of operating rpm. The valve regulates the airflow so as to prevent overheating of the APU, and will close automatically in the event of overheating in No.1 air conditioning system.

AIR CONDITIONING

MASTER VALVE warning lamps (2), amber press-to-test, on centre roof panel. Connect to amber master warning system. A lamp comes on, and its associated valve closes, as a result of excessive air temperature in the system.

MASTER VALVE switches (2), on centre roof panel. Rotary, left 'Close', centre 'APU', right 'Open'. When set to 'Open' with air pressure available, the valve maintains a constant mass flow to the air conditioning system; when set to 'APU' the valve regulates the mass flow, and also the pressure reducing valve closes, allowing the system to be supplied with air from the APU instead of from the engine. When set to 'Close' a bleed valve upstream of the master valve prevents the pressure in the ducting from rising far enough to operate the pressure override.

Both valves will close and their warning lamps will light when the master valves and conditioning fan isolation switch on electrical panel B has been set to 'Isolate' for maintenance purposes.

MAINS PRESSURE gauge (1), on centre roof panel. A dual gauge, showing the inlet pressure of each system, upstream of the Master Valves.

RAM AIR switch (1), on centre roof panel. Lock-toggle switch, up 'Normal', down 'Open'. When set to 'Open' the ram air valve opens in a duct between the starboard (No.2) cooling air intake and the mixing duct downstream of the temperature control valve, allowing outside air to ventilate the aircraft during unpressurised flight. When the switch is at 'Normal' the valve is closed.

SYSTEM TEMPERATURE gauge (1), on centre roof panel. A dual gauge, showing the inlet temperature of each system, upstream of the Master Valves.

TEMPERATURE

TEMP VALVE POSITION indicator dials (2), on centre roof panel, marked 'Cold-Inter-Hot'. One for flight deck, one for cabin. Show the settings of the temperature control valves at any time.

TEMPERATURE CONTROL switches (2), on centre roof panel, one for flight deck, one for cabin. Up 'Auto', left 'Dec', right 'Inc', centre off; spring-loaded to off from 'Dec' and 'Inc'. Each switch adjusts the position of its associated temperature control valve to vary the temperature of the conditioned air by changing the proportion of the hot air supply which passes through the valve to the air mixing duct, the remainder going to the air mixing duct through the refrigeration system. When at 'Auto', the temperature control valve is regulated by a temperature controller with its sensor in the flight deck or cabin, according to the datum temperature set by the Temperature Selector. The 'Inc' and 'Dec' positions enable the setting of the temperature control valve to be regulated manually; a high limit switch prevents the valve from being opened too far during manual control.

TEMPERATURE selectors (2), on centre roof panel, one for flight deck, one for cabin. Infinitely variable over the range marked 'Cooler-Normal-Warmer'. Each selector varies the datum about which the temperature controller regulates the temperature control valve.

CABIN TEMPerature gauge (1), on centre roof panel. Operated by a temperature bulb in the cabin.

MISCELLANEOUS

COOLING FAN ISOLATE switch (1), on electrical panel B (on port console post mod 21A092). Lock-toggle switch, up 'Isolate', down 'Normal'. When at 'Normal' the fan automatically provides cooling air for the heat exchangers at low airspeeds with the undercarriage down, and on the ground. Once started, the fan will keep running regardless of airspeed until the undercarriage is raised, its circuit breaker is pulled, or No.2 auxiliary hydraulic pump is switched on. When the switch is set to 'Isolate', the fan is disconnected from its electrical supply and both Master Valves are isolated from their switches so that they close to prevent overheating of the system; the Master Valve warning lamps light to indicate this. The switch is provided for maintenance purposes only.

FAN INTAKE switch (1), on electrical panel B (On port console post mod 21A092). Up 'Shut', down 'Auto'. When at 'Auto', the shutters over the cooling fan intake in the underwing fairing are controlled by undercarriage microswitches to open when the weight is on the undercarriage. When at 'Shut' the automatic control of the shutters is overridden. Air conditioning may be used with the shutters failed or selected 'Shut', but the cabin may become excessively warm in high ambient temperatures.

AIR control valve (1), in flight deck roof. Marked 'Increase-Decrease', controls the supply of conditioned air through the overhead diffuser.

INDIVIDUAL LOUVRES. Cool air is supplied to individually-adjustable outlets in the flight deck, passenger cabin, pantries and toilets from tappings downstream of the cold air units.

TOILET EXHAUST fan, controlled by circuit breaker on panel B, extracts stale air from toilets; the CB, B81, is identified by a fluorescent red/orange marker.

AIR CONDITIONING - GROUND SERVICING

PRESSURE RELIEF valve (2), in engine nacelle stub wings. If the pressure reducing valve and also the pressure sense override should fail, the pressure relief valve would operate. Normally flush with the under surface of the rear stub wing, the valve protrudes when it has operated, and can be reset only on the ground by replacement of the shear pins.

GROUND CONDITIONING connection (1), below port leading edge. Enable the aircraft to be ventilated by a ground air supply when its own system is inoperative; the Master Valves must be closed and the Discharge Valve must be fully opened by the Air Dump Valve control before the supply is connected. The supply is introduced directly into the distribution system.

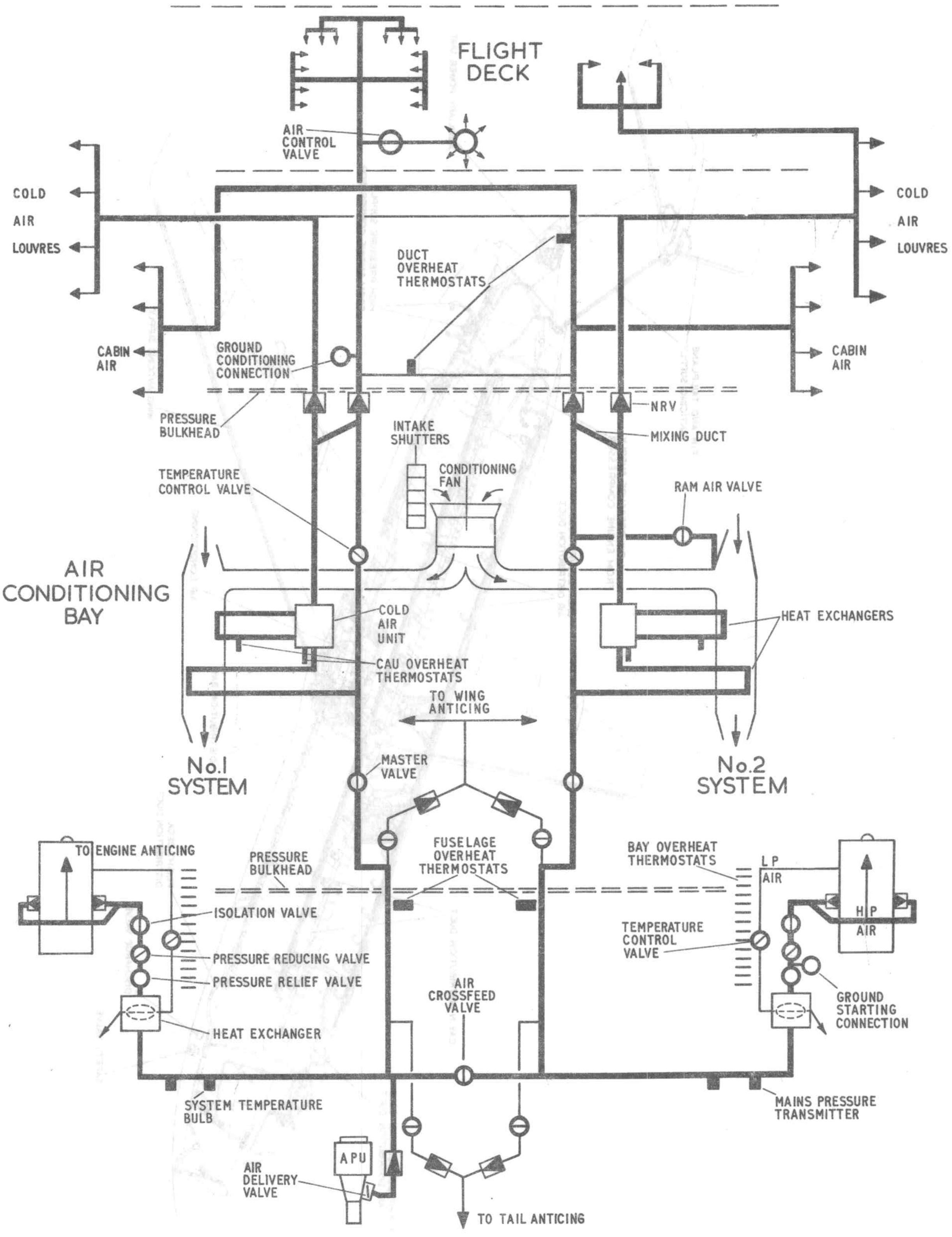


FIG. 1 AIR SUPPLY SYSTEM

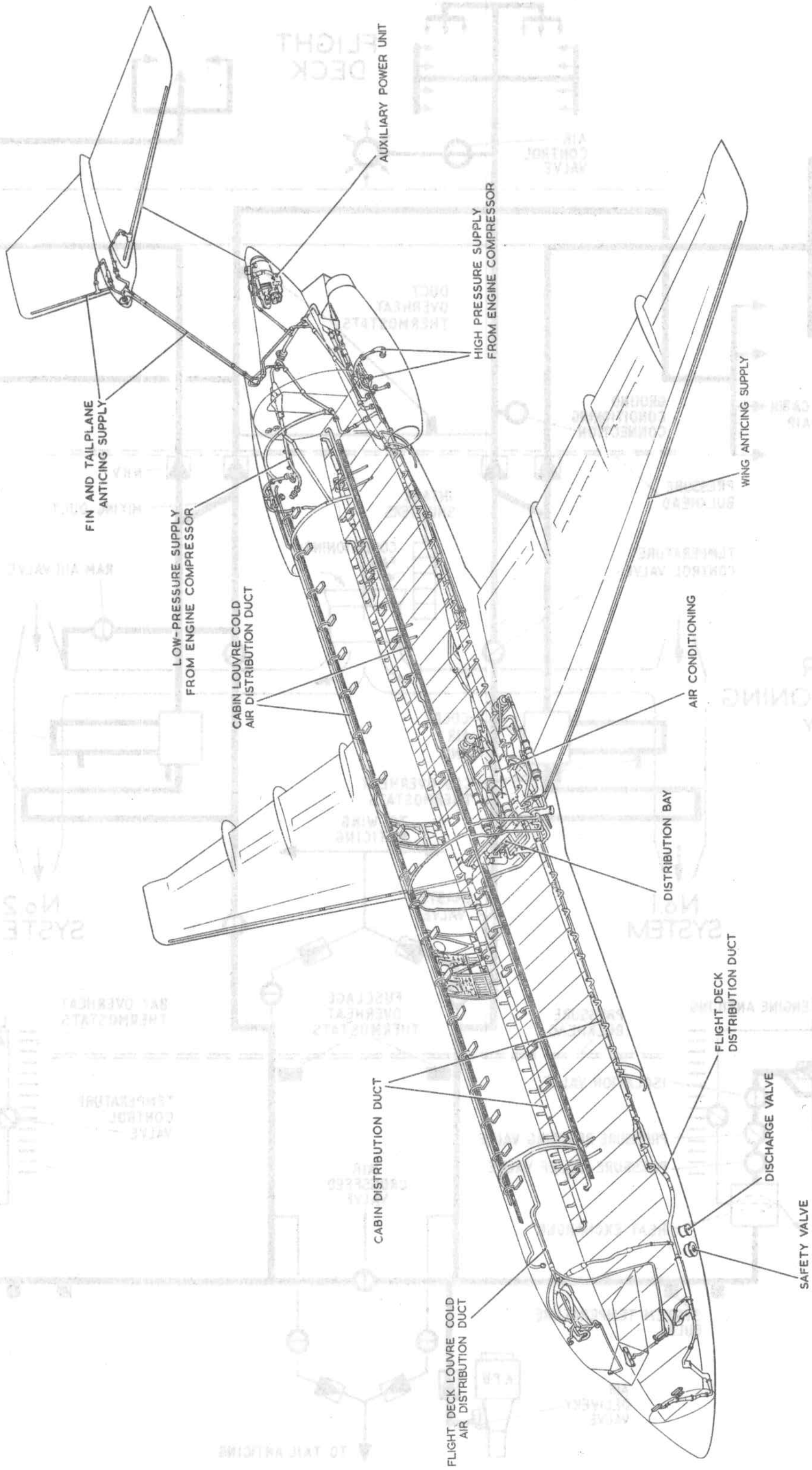

AUXILIARY POWER UNIT
HIGH PRESSURE SUPPLY FROM ENGINE COMPRESSOR
FIN AND TAILPLANE ANTICING SUPPLY
WING ANTICING SUPPLY
LOW-PRESSURE SUPPLY FROM ENGINE COMPRESSOR
CABIN LOUVRE COLD AIR DISTRIBUTION DUCT
AIR CONDITIONING
DISTRIBUTION BAY
FLIGHT DECK DISTRIBUTION DUCT
CABIN DISTRIBUTION DUCT
DISCHARGE VALVE
SAFETY VALVE
FLIGHT DECK LOUVRE COLD AIR DISTRIBUTION DUCT

FIG. 2 SUPPLY DUCTING AND EQUIPMENT

CABIN SELECTOR (1), on centre instrument panel. Centre knob rotates pointer to the required barometric pressure on the scales on the dial to provide a datum at which the desired cabin altitude is set by means of the knob marked 'A'. The rate of change of cabin altitude is set by the knob marked 'R', the normal setting being with the white spot uppermost.

In combination with the amplifier pack, the Cabin Selector regulates the supply of control air to the pneumatic actuator which adjusts the setting of the discharge valve so as to regulate the cabin differential pressure and the rate of change of cabin altitude.

If it is necessary to obtain an accurate cabin altitude, set 1013 mb on the barometric scale.

CABIN RATE-OF-CLIMB indicator (1), on centre instrument panel. Indicates rate of change of cabin pressure as a rate of climb or descent in feet per minute.

CABIN altimeter (1), on centre instrument panel. Indicates the cabin pressure in terms of feet of altitude, with a red sector starting at 9000 ft.

CABIN ALTITUDE warning lamp (1), red, on centre instrument panel, connected to the red master warning system. When the cabin altitude exceeds a pre-determined figure a pressure-operated switch causes the lamp to light.

CABIN PRESSURE gauge (1), on centre roof panel. Indicates the difference between cabin and ambient pressures. Has a red sector starting at 7.5 p.s.i.

SAFETY VALVE switch (1), on centre roof panel. A lock-toggle switch, up 'Normal', down 'Open'. Controls the operation of the combined safety/inwards relief valve. Normally at 'Open' before starting engines to minimise pressure surges on initiation of airflow, 'Normal' after starting, when the valve functions automatically as a safety valve or an inwards relief valve as necessary. Should the safety valve's main servo valve fail 'open', its reserve servo valve will then operate to maintain a safe cabin differential pressure.

DISCHARGE VALVE POSITION indicator (1), on starboard console. Shows the setting of the discharge valve at all times; used in conjunction with the adjacent Air Dump Valve control.

Actual setting of the dump valve is shown by pointer moving over scale reading from 'Shut' or 'Closed' to 'Open'.

AIR DUMP VALVE control (1), on starboard console. This control may be used to manually open or close the discharge valve. The control is extremely sensitive - only a small amount of movement is required to achieve the desired result.

To Open Discharge Valve:

1. Press control knob down to disengage dog-clutch.
2. Turn control knob slowly clockwise, monitoring the cabin ROC indication.

To Close Discharge Valve:

1. Press control knob down to disengage dog-clutch.
2. Turn knob slowly clockwise until cabin ROC indicator shows increased rate of climb.
3. Trip CB B53 (colour-coded green).
4. Turn knob slowly anti-clockwise, monitoring cabin ROC indication.

NOTE: If knob is turned anti-clockwise without tripping the CB, the discharge valve can close only as far as the pressure controller permits.

OXYGEN SYSTEM

OXYGEN CONTENTS gauge (1), on starboard console. Two sectors, yellow and 'Reserve' (green). When the pointer is in the green sector the system is at least nine-tenths full. On aircraft post mod 35A015 the '3/4 full' position is indicated by a red mark, and this is the minimum acceptable quantity for normal pressurised flight.

OXYGEN SUPPLY valve (1), on starboard console. When open allows oxygen to flow from the storage cylinder in the equipment bay to the double pressure regulator, provided that the valve in the head of the cylinder is open. (Normally wire-locked).

OXYGEN override control (1), at top of centre instrument panel. A barometric controller acts in conjunction with the double pressure regulator to control the pressure of the supply. If the cabin altitude rises above a certain figure the barometric controller causes the regulated pressure to increase and the override control to protrude. If required, the higher pressure can be obtained at any time by pulling the override control.

When the cabin altitude falls again, the barometric controller can be reset by pushing in the override control, whereupon the supply pressure will return to normal.

PASSENGER OXYGEN valve (1), on starboard console. When turned clockwise to 'Close' isolates the passenger supply system from the remainder of the system.

HOOTER knob (1), on starboard console. When rotated to 'Cancel' silences the warning hooter which sounds when its barometric controller senses an excessive cabin altitude.

RING MAIN PRESSURE OXYGEN gauge (1), on starboard console. Two green sectors, marked 'Norm' and 'Drop-out', two red sectors. Indicates which pressure is present in the system downstream of the double pressure regulator.

Crew Supply:

The crew main supplies three mask stowages in the flight deck roof. The masks have integral microphones and each can be released at will by pulling a red knob on the stowage. They will be released automatically when the supply pressure rises to the higher value, whether this is caused by the barometric control or by the manual override control. A self-sealing socket at each stowage provides for the connection of a smoke mask.

Passenger Supply:

Self-sealing sockets on eighteen of the passenger services units permit oxygen to be drawn when both the Oxygen Supply and Passenger Oxygen valves are open. The masks for use with these sockets are carried in a cupboard aft of the port toilet.

On aircraft post mod 35A027, one passenger oxygen mask is fitted with an extended hose, to be used to supply oxygen from the supply point above seat row 18 starboard to passengers in seat row 20; this mask can be identified by the green band on the hose near the connector, and by an orange band around the plastic bag in which it is packed.

Aircraft post mod 35A029 will carry nineteen supply sockets.

SMOKE MASKS (2), in stowages on port console and on bulkhead behind P2's seat. May be connected to the self-sealing sockets on the drop-out mask stowages, when, in addition to oxygen being supplied, the microphones in the masks will be connected and will, in conjunction with the headset earphones, permit normal intercom and R/T communication. Alternatively one mask may be connected to the 310 litre oxygen cylinder which is carried at the rear end of the port console. Whatever its source, the oxygen supply must be connected and flowing before the mask is put on.

A speech diaphragm in each mask may be used for person-to-person communication, and also permits normal intercom and R/T communication when the headset microphone is placed over it.

PORTABLE OXYGEN SETS (3), two below forward cabin crew seat, one on cabin port rear bulkhead. Each set comprises a cylinder and a mask, the cylinder having a rotary control marked 'Open-Closed', a contents gauge, and two bayonet outlet connections. Oxygen flows only when the mask is connected to one of the outlets.

OXYGEN SYSTEM - GROUND SERVICING

CHARGING VALVE (1), on port side of electrics bay. Enables the storage cylinder to be recharged in situ. Should the pressure in the system become excessive for any reason, a bursting disc will rupture, discharging the oxygen overboard through a vent pipe.

CYLINDER STOP VALVE (1), on head of storage cylinder. Normally wire-locked open.

OXYGEN CONTENTS gauge (1), beside the Charging Valve. Identical to that on the starboard console, it is for use when re-charging the storage cylinder.

ICE AND RAIN PROTECTION SYSTEMS

ICE DETECTION

ICE WARN lamp (1), red, press-to-test, on centre roof panel. Connected to the red master warning system. Comes on when ice forms on the rotating detector on the port side of the nose, goes out when ice formation ceases, provided that both engine anticing switches are at 'On'; if both engine anticing switches are not 'On', the lamp will remain on when ice formation ceases. Oleo-controlled relays prevent the detector from operating when the aircraft is on the ground.

ICE INDicator switch (1), on centre roof panel. Up 'Light', centre 'Off', down 'Heat', spring-loaded from 'Heat' to 'Off'. When at 'Light', illuminates the visual ice indicator rod outside the Captain's DV window to permit inspection for ice accretion at night. When at 'Heat', the rod is heated to disperse the ice and is also illuminated.

ICE INSPection switch (1), on centre roof panel. Up 'On', down off. Controls lamps in the fuselage sides ahead of the wing and in the wing trailing edge fillets which illuminate the wing leading edges and engine intakes respectively.

ICE DETECTOR TEST switch (1), under the 'Intercom' panel near the ice detector, spring-loaded to off. When held to 'Test' enables operation of detector and ice warning lamp to be checked on the ground by over-riding the oleo-controlled relays.

ICE AND RAIN PROTECTION SYSTEMS

AIRFRAME ANTICING

WING antice switches (2),
TAIL antice switches (2), on centre roof panel. One of each for each anticing system. Up 'On', centre 'Off', down 'Test', spring-loaded from 'Test' to 'Off'. When set to 'On' the appropriate shut-off valve is opened (provided there is air pressure in the ducts and the weight is off the undercarriage) to connect the related air supply system to the wing or tail anticing system. When set to 'Test' the undercarriage cut-out is overridden and the shut-off valves open, allowing hot air to flow past the temperature sensors in the ducts, giving a change in the reading of the temperature gauge.

Either system can supply the whole of the wing and tail anticing if required.

WING, TAIL temperature gauge (1), on centre roof panel. A dual gauge, calibrated 0-300°C, with red, green, red sectors. Pointers are actuated by sensors in the anticing air supply ducts.

ICE AND RAIN PROTECTION SYSTEMS

ENGINE AND INTAKE ANTICING

ENG 1 antice switch
ENG 2 antice switch, on centre roof panel. Up 'On', down off. When a switch is set to 'On' duplicated air control valves open to allow high pressure engine bleed air into the system, and thereafter regulate its pressure. The air circulates through the intake guide vanes and inlet hub fairing, then through the nose cowling, and exhausts to atmosphere through outlets above the leading edge of the nacelle fairing.

ENGINE AIR PRESSURE gauges (2), on centre roof panel, one for each engine. Indicate the pressure downstream of each pair of air control valves.

The purpose of the engine air pressure gauge is to serve as an indication that anticing air pressure is available and that the regulating valve is open. If at any time there is doubt that an engine anticing regulating valve is operating, this can be checked by opening the throttle which will increase the engine anticing pressure reading to between approximately 45 - 57 psi; after reaching its maximum, the pressure may start to fall off as higher engine speeds are used - this is particularly true at low altitudes.

ICE AND RAIN PROTECTION SYSTEMS

PITOT PROTECTION

PITOT HEATERS ammeters (5), on left hand and centre roof panels. Marked from left to right, 'Lower Stbd - DC amps', 'Q - AC amps', 'Q - AC amps' 'Port - DC amps', 'Stbd - DC amps'.

Each ammeter gives an indication of satisfactory operation of the pitot head heater element controlled by the associated switch.

PITOT HEATERS switches (5), on left hand and centre roof panels, adjacent to their associated ammeters. Up 'On', down off. Control heater elements as follows:-

'Lower Stbd' switch - Lower starboard pitot head.

First 'Q' switch - Port Q feel pitot head and port stall recognition sensor.

Second 'Q' switch - Starboard Q feel pitot head and starboard stall recognition sensor.

'Port' switch - Port pitot head and port stall warning sensor.

'Stbd' switch - Starboard upper pitot head and starboard stall warning sensor.

HEATERS FAIL warning lamps (4), amber, press-to-test, on left-hand roof panel. Marked 'Warn - 1, 2', and 'Rec - 1, 2'. A lamp illuminates in the event of failure of the heater element in its associated stall warning or stall recognition sensor, and also when the heater is not switched on.

ICE AND RAIN PROTECTION SYSTEMS

WINDSCREEN PROTECTION

WINDSCREEN heating switch (1), on centre roof panel. Up 'Normal', centre 'Off', down 'High'. Controls the electrical supplies to transparent gold film heating elements between the laminations of the two windscreen panels. When at 'Normal' the panels are heated sufficiently for normal anticing and demisting purposes and to improve resistance to bird impact. When at 'High' a greater degree of heating is provided for severe icing conditions. The temperature of each windscreen panel is thermostatically controlled within a working range.

WINDSCREEN O/HEAT warning lamps (2), amber, press-to-test, on centre roof panel. Connected to the amber master warning system. If the thermostatic control of either windscreen panel should fail, an overheat sensing element will cause the heating supply to be cut off and the overheat warning lamp to come on. When the temperature falls to the upper end of the working range the supply will be restored and the warning lamp will go out.

WINDSCREEN U/HEAT warning lamps (2), amber, press-to-test, on centre roof panel. Connected to the amber master warning system. A lamp will come on when the temperature of its associated windscreen panel falls to a pre-determined value, and will go out when the temperature rises to the lower end of the working range.

SIDE WINDOW heating switch (1), on centre roof panel. Up 'On', down off. Controls the electrical supplies to the gold films of the DV and side windows to provide heating sufficient for de-misting. The supplies to the DV windows are further controlled by micro switches and sliding contacts, so that these windows are heated only when closed and locked. The temperature of the windows is thermostatically controlled within the same working range as the windscreen panels, there being a controller for each side and overheat cut-outs which operate in the event of controller failure.

WINDSCREEN WIPERS controls (2), on control pedestal. Rotary controls marked 'Off', 'S', 'F'. Each controls the supply of fluid to the hydraulic motor which operates the associated wiper arm, giving infinitely variable control of wiper speed. The port wiper is supplied by

No.2 hydraulic system, and the starboard wiper by No.1 system. When a control is set to 'Off', the wiper arm parks automatically at the bottom of the windscreen.

RAIN REPELLENT selector (1), on port console. Three-position cock, left '1', centre 'Off', right '2'. Selects the container from which the supply is drawn.

RAIN REPELLENT switches (2), on control pedestal, marked 'Up to operate', spring-loaded down.

The Rain Repellant system is inoperative.

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FLIGHT CONTROLLER

GENERAL. The Flight Controller allows selection and operation of Flight Director and Autopilot functions excluding radio inputs. It contains servo-mechanisms and circuits for deriving Autopilot and Autothrottle manometric and pitch attitude lock error signals, and relays to provide the interlocks and to control the switching of signals.

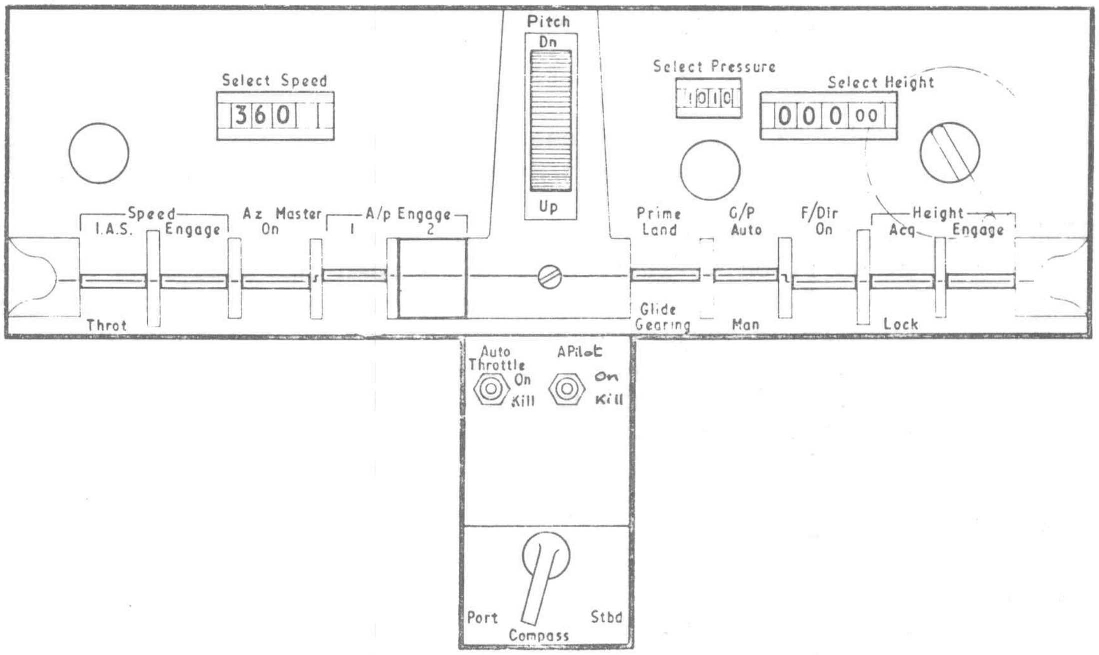


FIG.1 FLIGHT CONTROLLER

The various controls function as follows:-

A/P ENGAGE switch. Sprung to the centre off position, the switch is held by solenoid at 'A/P Engage', the solenoid supply being controlled by the interlocks.

At 'A/P Engage', power is supplied to the pitch, roll and rudder channel engage relays and servo motor clutches, and also to the pitch trim servo motor clutches.

At the moment of Autopilot engagement any locks (except Throt) on, go off so that the system is engaged in Unmonitored Heading Mode and the aircraft is held at the existing pitch attitude. If there is any bank angle, wings are levelled.

The Autopilot cannot be engaged unless:-

Vertical Gyros 1 & 2 are erected (2 mins from switch-on) -

All engage interlocks are made and -

6 secs have elapsed since auto-disconnect.

NOTE: In flight, 15 secs should elapse after auto-disconnect to allow flight disturbances to decay before re-engaging.

PITCH control. This rotates freely to allow a ±17° adjustment of the Autopilot pitch attitude hold datum when the Autopilot is engaged in any mode except IAS or Height lock, during the final stage of an acquire or coupled to a glide path. In the three modes mentioned, and when the Autopilot is disengaged, the control rotates without effect. On disengagement of the Autopilot, adjustments made with the control during engagement are automatically zeroed. Maximum rate of pitch control is 1.5° of elevator/sec.

SELECT SPEED counters
SPEED selector
IAS/THROT switch
ENGAGE switch. Airspeed lock controls. The speed counters present the IAS, as sensed by the Air Data Computer, only whilst IAS or Throt locks are not engaged. When a lock is engaged, the datum speed is the IAS at that instant; the speed selector then becomes effective, allowing the counters to be set to the datum speed required. Turned clockwise to increase speed, detent positions can be felt at 1 knot intervals. Departures from this speed, in IAS lock, then produce pitch demands, limited to ±4°, until the difference is zero; in Throt lock it is zeroed by (auto) throttle adjustment.

Regardless of the rate at which the Speed selector is turned, the maximum rate of pitch change is 1.5 of elevator/sec.

The IAS/Throt switch is sprung to 'Throt' and solenoid held at 'IAS'. The 'Engage' switch is sprung to off and solenoid held at 'Engage'. Both switches' hold-on solenoid supply is controlled by interlocks which prevent incompatible modes being engaged at the same time, or prevent the mode engagement without supporting systems.

IAS lock cannot be engaged without prevous engagement of the Autopilot nor when a glide path is coupled. It will automatically change to 'Throt' lock, which remains engaged, when Height Lock is selected, or at the beginning of the flare on to an 'Acquire' height.

Throt lock may be engaged independently of the Autopilot and is incompatible only with IAS lock. The shared IAS/Throt selector switch prevents the incompatibility from arising. If the speed counters readout is not within ±4 kts of the actual ADC IAS, Throt lock cannot be engaged. After engagement, tolerances allow the IAS to be up to 6 kts more than the selected speed.

AZ MASTER on/off switch. With the switch 'On', radio displacement and/or heading error signals may be passed to the Autopilot and, with the F/Dir switch 'On', the Flight Director. The heading error signals arise from the displacement between the Drift Index and the Track Pointer Head, Tail or Steering Index, depending on the Radio Coupling Switch position, of the selected compass. With the Drift Index placed under the compass fixed lubber as it will normally be, the lubber may be regarded as the heading error signal datum.

With the switch off there is no azimuth control of the Autopilot or Flight Director.

Maximum bank angle demand is 28° ± 15% except when coupled to a glide path, below 1200 ft, with Prime Land or Glide Gearing selected, when it becomes 15° ± 15%.

The Azimuth Master switch goes off on engagement of the Autopilot in order to disengage the Flight Director and thus to ensure that Flight Director and Autopilot coincide and to ensure also that the latter cannot be engaged with a large demand present. It may then be put 'On' again.

HEIGHT ACQ/LOCK switch
ENGAGE switch
SELECT PRESSURE counter & control
SELECT HEIGHT counter & control. These allow locking to an existing height; or climb or descent and automatic locking to, any pre-selected height controlled by either IAS lock or Throttle lock. The term height will be seen to mean height, altitude or flight level throughout.

The 'Select Pressure' control is rotated to set the digits as required, from 850 to 1050 mb; this will not vary the Select Height reading. Height above datum may be set as required by rotating the Select Height control provided:-

Height 'Lock' is not engaged -

Flare on to an Acquire height has not started -

'GP MAN' is not selected -

A glide path is not yet coupled on 'GP AUTO' -

The Acq/Lock switch is sprung to 'Lock' and held at 'Acq' by solenoid. The 'Engage' switch is sprung to 'Off' and held at 'Engage' by solenoid.

To lock to an existing height, the 'Acq/Lock' switch is left at 'Lock' and the Engage switch is put on, where it will stay provided a glide path is not coupled. IAS lock, if engaged will change to 'Throt' which will remain engaged. The Autopilot will then maintain the height at the moment of engagement. This datum cannot be varied whilst engaged.

To acquire a pre-selected height 'Acq' and 'Engage' are selected. The climb or descent to the pre-set height may then be initiated manually by throttle and/or pitch attitude adjustment, depending on whether 'IAS' or 'Throt' lock is engaged. Then, at a height error determined by the vertical speed, the flare on to the selected height begins.

/Cont'd. ...

At this time, the IAS lock if engaged, reverts to 'Throt' and the 'Pitch' and 'Select Height' controls are de-clutched. On reaching the required height the 'Acq' position 'Hold on' is relaxed and the switch reverts to 'Lock'.

Assuming the datum set on the Select Pressure counter is the same as that set on the altimeter, the aircraft will maintain the selected height to within ±300 ft at 30,000 ft, down to ±100 ft at sea level.

To ensure capture, the required height will normally be overshot by up to 45 ft per 1000 ft/min of vertical speed.

F/DIR. Flight Director master switch. Sprung to off, held 'On' by solenoid. At 'On' the switch connects Flight Director demand signals to the Pitch and Bank Directors on the Attitude Directors. Pitch demands are presented on the Pitch Director only when coupled to a glide path or when using the F/Dir Pitch control. An interlock puts the F/Dir switch off when the Az Master is off.

GP AUTO/MAN switch. This allows auto or manual coupling to a glide path. Sprung to centre off, it is held on by solenoid at 'Auto' and 'Man'.

Auto. This will hold on provided an ILS localiser frequency has been selected, the relevant Nav system is selected into the FCS and the Mode Indicator shows 'Beam'. If the aircraft is away from the glide path centre line nothing happens except that the Autopilot is armed ready for coupling. On reaching 1/10 dot deviation from the centre line, the glide path is coupled and elevator control signals are then derived from GP + Vertical Gyro + Pitch Rate. At capture, the glide-path may be overshot to the extent of 1.3 dots up. If the glide path is captured from level flight with Height Lock engaged, the Height Engage switch goes 'Off' and a 2° pitch down demand is injected to assist capture. If the glide path is captured when descending under manometric or attitude pitch control these are disengaged, 'Pitch' control is de-clutched, and the IAS/Throt switch goes to 'Throt'.

Man. This would be selected on reaching the glide path as shown by the Glide Path Pointer.

If Height lock is on, it will disengage and a 2° pitch down command is injected to assist capture.

PRIME LAND/GLIDE GEARING switch. Sprung to centre off, this is held at 'Prime Land' or 'Glide Gearing' by solenoid and primes the FCS for (Prime Land) or (Glide Gearing) approach.

/Cont'd. ...

The different functions of the Glide Gearing and Prime Land switch positions are shown in Cat 1 & 2 Appproach Events.

A/PILOT switch. Marked On/Kill, this controls the 3 phase 115v AC and 28v DC power supplies.

AUTOTHROTTLE switch. Marked On/Kill, this controls the single phase 115v AC supply.

COMPASS Port-Stbd. switch. This selects the Compass from which heading and radio information is fed to the Autopilot and Flight Director.

AUTO FLARE test button and magnetic indicator. Mounted on the throttle quadrant, pressing the button checks the flare phase monitoring. If this is serviceable the MI goes from blank to cross-hatch. The MI returns to blank when the button is released.

AUTOPILOT

GENERAL. The Elliott 2200 Monitored Single Channel Autopilot incorporates three sub-systems which drive the rudder, elevators and ailerons. Co-ordination in azimuth is provided by integration of rudder and aileron control.

The basic stabilising drive from the three sub-systems originates in sensor signals from which are computed demand signals. These are amplified to drive servomotors which in turn move the appropriate control run. Additionally, demand signals arising from coupling to heading, manometric or radio facilities may be injected.

The primary Autopilot sensors are:-

Three Axis Rate Transmitter

Vertical Gyros 1 & 2

Dynamic Vertical Sensor

Air Data Computer

Heading signals are taken from the selected Flight Compass and radio signals from the Omnitrac and Radio Nav Systems.

The Autopilot is controlled at the Flight Controller and either of the Flight Compasses which allow operation in the following modes:-

| Unmonitored Heading (Az Master off, no azimuth datum control)

Variable Heading (Az Master On)

IAS Lock

Height Acquire

Height Lock

Omnitrac

VOR

Localiser

Glide Path

THREE AXIS RATE TRANSMITTER. Mounted at Panel RE. the Radar & Gyro tray. This incorporates three gyros which measure rate of rotation in pitch roll and yaw. Proportional signals are generated, amplified and used by the control servomotors to damp out flight path disturbance.

VERTICAL GYROS (3) Panel RE. These are employed as shown in the Attitude & Flight Director System, VG1 providing the main vertical reference for the Autopilot. As well as pitch and roll signals, it also provides the versine signal which counters height loss in turns.

As VG2 supplies the signals for the pitch and roll monitoring, failure of this or VG1 will cause loss of the Autopilot.

DYNAMIC VERTICAL SENSOR. Panel RE. This is a pendulum operated device which detects sustained slip or skid and originates rudder control signals to correct it.

AIR DATA COMPUTER. Panel RD electronics bay. This converts pitot and static pressure into signals which are used to:-

Modify Autopilot response according to height and airspeed -

Provide airspeed control in IAS (by pitch attitude) and Throt modes -

Provide height control in Height Lock and Height Acquire modes, by pitch attitude control.

AUTOPILOT TRIM INDICATORS. For rudder, ailerons and elevators, these are mounted together, as shown in Fig.1, on the centre instrument panel. They show the direction and magnitude of any command signals being applied to the servomotors with the Autopilot disengaged or, the out-of-trim state of the aircraft with the Autopilot engaged.

Before Autopilot engagement the Trim Indicators should be 'floating' about the 'in-trim' position.

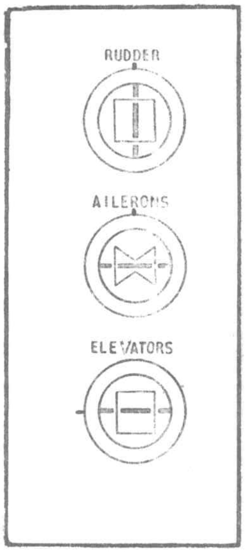


Fig.1
TRIM INDICATORS

AUTOPILOT CUT-OUT. A Cut-Out button is mounted on each control column handgrip.

The Autopilot may also be cut out by applying a load on the control column in either direction, sufficient to cause the monitor to disconnect, or by selecting 'Kill' at the 'A/Pilot' switch.

A/PILOT. Engaged/Off MI (2). One on each main instrument panel, these are the dolls-eye type showing ENG or OFF as appropriate.

AUTOPILOT AUTO-DISENGAGEMENT WARNINGS. Visual and audio warnings of Autopilot auto-disconnect are provided.

A/Pilot Discon. w/lts. A red ptt lamp on each main instrument panel, energised from the Essential DC Bus, flashes if the Autopilot disconnects for any reason other than use of Cut-Out button or selection of 'Kill' at the 'A/Pilot' switch. Pressing either Cut-Out button then puts out both lights.

If the lamps' normal 28V DC supply fails, a stand-by supply from the Autopilot junction box is connected so that the lamps are now on steady when the Autopilot is engaged, and go out when it is disengaged regardless of reason.

Audio Warning. A two tone gong sounds in the telephones if the Autopilot disconnects for any reason other than use of Cut-Out button or selection of 'Kill' at the 'A/Pilot' switch. This may be cancelled by pressing either Cut-Out button whereupon the two tone changes to a steady note for two seconds and then stops. A $\frac{1}{2}$ sec note sounds in the telephones on using either Cut-Out button to disengage the Autopilot.

PITCH MONITOR. This incorporates four monitoring circuits as follows:-

Elevator Hardover Monitor -
Elevator Servo Clutch Monitor -
Tailplane Trim Monitor -
Pitch Demand & GP Comparison/Performance Monitor.

Elevator Hardover Monitor. This is in operation whenever the Autopilot is engaged and disconnects the Autopilot in the event of a failure which might otherwise cause the elevators to be operated fully in one direction.

The monitor compares the elevator servo position and rate with a synthetic elevator demand signal. If there is a difference equal to 2° of elevator displacement, autodisconnect takes place.

Elevator Servo Clutch Monitor. Operating whenever the Autopilot is engaged, this protects the aircraft from failure of the elevator servomotor or clutch by autodisconnect if a variation of more than ±50% in the servomotor clutch current is detected.

Auto Trim warning lamp.
Tailplane Trim Monitor. This protects the aircraft from disturbance which might result on autodisconnect with the tailplane out of trim.

With a glide path coupled and Glide Gearing or Prime Land set, the amber Auto Trim ptt warning lamp on the centre instrument panel comes on if a sustained torque equal to 3.5° of elevator is applied for more than 20 seconds. The lamp remains on for 20 seconds after the auto trim has reduced the torque to less than 3.5°.

Pitch Demand & GP Comparison & Performance Monitor. This monitors GP performance and the computation of pitch demands arising from GP deviation.

The comparison monitor is operative when below 1200 ft (QFE) with Glide Gearing or Prime Land set. This converts a pitch demand signal back to a GP deviation signal and compares it with a GP deviation signal that has been fed direct to the monitor. A fault condition equivalent to a difference between these two signals of 0.1° (1/4 dot) of GP deviation, opens the interlock line which in turn causes autodisconnect.

The performance monitor is operative with Prime Land set from 400 ft R down to 100 ft R and opens the interlock line at 0.36° (about 1 dot) of GP deviation.

AZIMUTH MONITOR. This incorporates six monitoring circuits which begin to operate at 400 ft R with Prime Land set. These are:-

Aileron & Rudder Hardover Monitor
Aileron & Rudder Clutch Monitor
Bank Demand Monitor
Localiser Comparator & Performance Monitor

/Cont'd. ...

Aileron & Rudder Hardover Monitor. These disconnect the Autopilot in the event of a failure which might otherwise cause their associated control surfaces to be operated fully in one direction.

The Aileron Monitor compares the aileron servo position and rate with a synthetic aileron demand signal. If a difference equivalent to 3° or more of aileron position is detected, the interlock line is opened thus disconnecting the Autopilot.

The Rudder Monitor compares the rudder servo position and rate with a synthetic rudder demand signal. If a difference equivalent to 4° or more of rudder position is detected, the interlock line is opened thus disconnecting the Autopilot.

Aileron & Rudder Clutch Monitors. These protect the aircraft from failures of the aileron and rudder servomotors or clutches by autodisconnect if a variation of more than ±50% in the servomotor clutch current is detected.

Bank Demand Monitor. This compares the bank demand signal with a synthetic signal derived from beam error and bank attitude signals. A bank demand error of 6° or more causes a disconnect via the interlocks.

Localiser Comparator & Performance Monitor. This ensures that the localiser beam error signal is reliable and that the localiser performance is acceptable.

The Autopilot will disconnect if deviation from the localiser becomes 1° (1 dot) or more, gradually reducing with height to 0.41° (1/3 of a dot) at 200 ft radio alt.

Autodisconnect will follow also as soon as deviation reaches 0.41° (1/3 dot) on malfunction of the localiser signal.

MODE INDICATOR

Mounted one on each of the port and starboard instrument panels and except for AZM, operating in parallel, the apertures (Fig. 1) are lit to show as follows:-

SPEED - IAS lock engaged
ACQ - Acquire Height selected (2)
HT - Height Lock engaged
THROT - Throttle lock engaged (3)
AZM - AZ Master On and, F/Dir On or A/P engaged (4)
BEAM - LOC or VOR coupled (5)
GP - Glide path coupled (6)

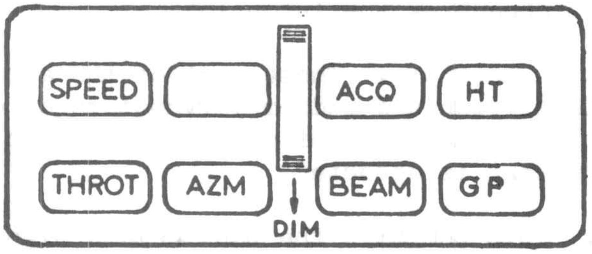


FIG 1. MODE INDICATOR

Notes:

1. 'Acq' flashes whenever the Autopilot is engaged unless -
   Height 'Lock' and 'Engage' are selected or
   Height 'Acq' and 'Engage' are selected or
   A glide path is coupled.

2. 'Throt' flashes on autothrottle failure.

3. 'Azm' normally shows only on the side selected on the 'Compass' switch. With Prime Land or Glide Gearing selected and a G/P coupled, it flashes on both sides at more than 1/3 of a dot deviation from the localiser. (= 65 ft off centre at 100 ft).

4. 'Beam' flashes with Prime Land or Glide Gearing selected if the LOC signal becomes unsatisfactory of fails.

5. 'GP' flashes from Glide Gearing or Prime Landing selection down to 100 ft R (down to ground in manual flight with F Dir engaged), if:-

   The GP signal becomes unsatisfactory or fails -
   GP deviation Pointers disagree by more than approx ¼ of a dot or -
   There is more than approx 1 dot deviation from the glide path. (= ±15 ft off centre at 150 ft).

LAND ANNUNCIATOR

Mounted one on each main instrument panel, this is a four position dolls eye type magnetic indicator showing Blank, GLD, ARM or ATT phases of autoapproach as shown in Cat 1 & 2 Approach Events.

INTERLOCK FAILURE MONITOR

GENERAL. The A/P Engage switch hold-on solenoid is energised via an interlock line having a number of interlock contacts connected in series. Any one of these being open will prevent engagement or cause disengagement of the Autopilot.

The Interlock Failure Monitor continuously monitors the interlock line and indicates which of the contacts has opened. The system employs an IFM Display unit and the Interlock Failure Monitor unit.

IFM DISPLAY unit. Mounted on shelf 2 of the flight deck radio rack, a hole in the covering panel allows the face of the unit to be seen by P1 when in his seat.

The display features 36 red lamps numbered 1 to 36, each of which may be associated with an interlock, and which is lit when that interlock is the original cause of an auto-disconnect or failure to engage. The interlocks associated with the numbers are as follows for a Cat 2 system with Autoflare Computer fitted.

1 Pitch comptr failure
2 Disconnect button
3
4 DC power or Att monitor
5 Roll att monitor below 20 ft R
6
7 Vertical Gyros
8 Pitch A/P engage
9
10
11 Pitot-Static monitor
12 Ail. & rudder clutch monitor

/Cont'd. ...

13 Bank demand monitor
14
15 Aileron hardover monitor
16 Rudder hardover monitor
17
18
19 LOC monitor
20 A/Throt or Rad Alt monitor
21 Ht switch monitor
22
23 Flare logic monitor
24 Pitch att comparator
25
26
27 GP monitor
28 Elev. clutch monitor
29 Rad Alt monitor below 100 ft or Prime Land monitor
30
31 Pitch monitor
32 Elev. hardover monitor
33
34
35 Pitch monitor
36

Only one lamp should be lit at any time and this must be put out, to allow the system to operate again, by use of either the switch on the Display Unit or the button on the pedestal. However, a fault in the Unit may cause unallocated lamps to light.

Reset/Test switch. Mounted on the front of the Display Unit, the 'Reset' function is the same as that on the IFM Reset button on the pedestal. The 'Test' side is for maintenance purposes.

IFM RESET button. Mounted on the aft edge of the pedestal, the button is pressed momentarily to put out a light and to re-cycle the logic if the reason for it being on is no longer present or the disconnect has been noted.

INTERLOCK FAILURE MONITOR UNIT. This is carried on shelf 6 of the electronic bay rack.

A sensor circuit detects that the A/P Engage switch hold-on coil circuit is open. A scanner circuit then 'looks' at each interlock, establishes which one is open and causes the relevant lamp on the IFM Display to be lit. Other interlocks opening as a result of the first do not bring on their associated lamps.

POWER SUPPLY. Radio & Electronic AC Bus 1 as shown in Power Supplies & Cooling. There is no power control switch.

APPROACH EVENTS

GP Engage

GP sigs fed into Pitch demand -
Fixed GP gearing -
Fixed Pitch, Att & Rate terms increased -
Nose-down datum signals fed into demand chain if GP captured with Height lock on -
Red MWS for A/Throt disconnect -
Pitch demand rate limit increased to 3° of elevator per sec.

Height — Glide Gearing Selected — Prime Land Selected

1200 ft QFE

Land Annunciator GLD
GP Comparator Monitor active -
Auto-Trim w/lt active -
Bank demand limit reduced to 15°-
LOC integral bank law introduced -
Pitch demand rate limit increased to 11° of elevator per sec -
Autopilot autodisconnect if controlling NAV receiver power off.

Mode Ind AZM flashes for $\frac{1}{4}$ dot devn. from LOC. -
BEAM flashes if LOC signal becomes unsatisfactory or fails -
GP flashes if GP signal becomes unsatisfactory or fails or -
If GP devn. pointers disagree by more than $\frac{1}{4}$ dot or -
If there is more than 1 dot devn. from the glide path.

Prime Land Selected:
Airspeed error term included in GP control law. Elevator demand limited. Radio Altimeter or Pitot - Static Monitor failure will cause Autopilot autodisconnect.

400 ft R

Prime Land Selected:
Land Annunciator ARM -
All monitors active -
Autodisconnect and Land Annunciator goes blank if any approach monitor in fail condition -

Height	Glide Gearing Selected	Prime Land Selected
200 ft R	GP gearing halved.	
100 ft R	(Altitude Hold Land annunciator remains at GLD)	Land Annunciator ATT (Attitude Hold) -
	GP Performance Monitor off - Mode Ind GP steady.	
90 ft R	Autodisconnect if Attitude Hold not achieved.	
50 ft R	(Manual disconnect required)	Land Annunciator blank. Throttles start to close and flare begins. A/Pilot and A/Throt interlocked; disengagement of either causes the other to disengage. Airspeed error 6 kt limit removed for elevator demand in nose-up sense.
20 ft R	N/A	Bank angle comparator introduced to give disconnect if bank angle exceeds $4.5^\circ \pm 0.5^\circ$.
Touchdown	N/A	(Manual disconnect required)

COMPASS SYSTEM

GENERAL. The Compass System comprises two separate identical gyro-magnetic compass systems, one providing the port heading display and the other the starboard. Either system may provide a heading monitoring signal for the Autopilot and heading information for other units, the choice being made at the 'Compass' switch on the Flight Controller. Either system may be used as a directional gyro.

Magnetic heading indication is accurate to within $\pm 1^\circ$ provided the deviation and latitude compensation is correct. In the DG mode with correct latitude compensation, random drift does not exceed 3°/hour.

Automatic beam capture is provided and allows interception at any angle within 90° relative to the beam QDM or QDR. The angle prior to capture is determined by the Steering Index setting and is the angular difference between this and the Track Pointer Head setting. The final intercept angles are, LOC 40° VOR 18°.

The complete system incorporates:- 2 Directional Gyros, 2 Detector Units, 2 Master Compass Units, 2 Flight Compass Amplifiers, 2 Flight Compasses. These are briefly described.

DIRECTIONAL GYRO. This is a hermetically sealed, low drift-rate electrically driven azimuth gyro providing a short term directional reference in the compass mode and a long term reference in the DG mode.

In the Compass mode it is monitored by reference to the earth's magnetic field except during aircraft turns at more than 15°/min. The inhibition during turns avoids sensing the vertical component of the earth's field and prevents the erroneous heading signals which would otherwise result.

DETECTOR UNIT. The Detector Unit, mounted in each wing tip, senses the direction of the earth's magnetic field relative to the aircraft heading and produces two signals proportional respectively to the sine and cosine of the angle between the aircraft heading and the earth's magnetic meridian. The detector elements are pendulously mounted so they remain in the horizontal plane and are sensitive only to the horizontal component of the earth's magnetic field. The two signals produced are fed to a resolver synchro in the Master Compass Unit.

MASTER COMPASS UNIT. This passes magnetic or DG heading information to the Flight Compass and the heading monitoring signal to the Autopilot; four additional synchros pass the same heading information to other units. The unit compares heading information from the Directional Gyro with magnetic heading information from the Detector Unit and provides a signal to monitor the gyro.

The front panel carries the deviation corrector controls, the lattitude correction control, a monitoring current meter, a digital heading indicator and a turn reset indicator.

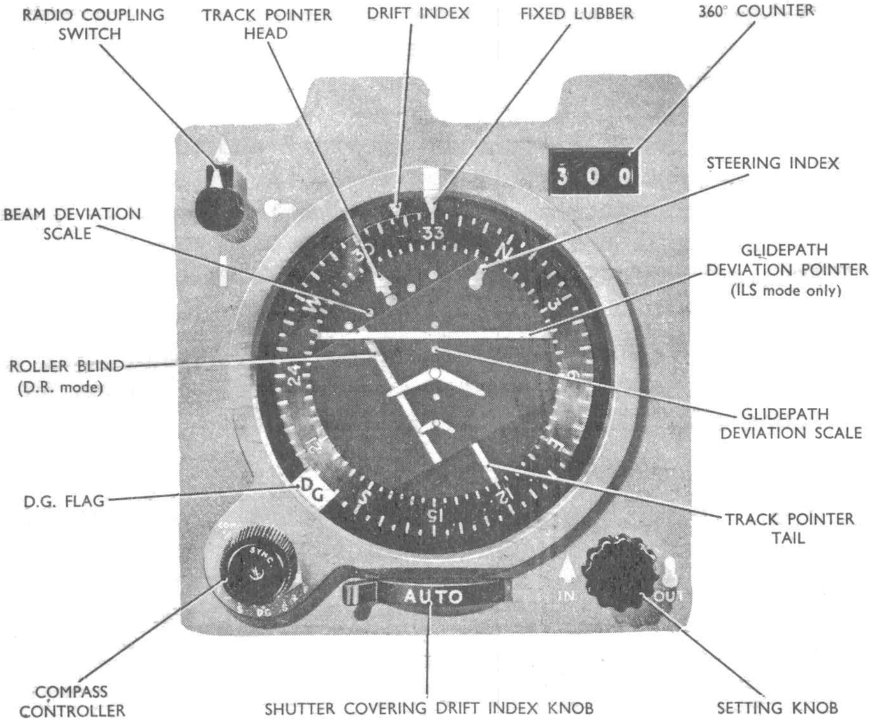


FIG.1 FLIGHT COMPASS

FLIGHT COMPASS DISPLAY AMPLIFIER. This incorporates the amplifier and other circuitry associated with the Flight Compass. It also provides the fixed supplies to the motors in the Flight Compass and the DC supplies for radio switching circuits.

FLIGHT COMPASS. Fig.1 shows the Flight Compass with the presentation abnormally disposed and annotated. The various controls etc., are briefly described.

COMPASS CONTROLLER. Selected to Comp for conventional gyro compass use, the monitoring rate is $3^{\circ} \pm 0.3^{\circ}$/min and the compass card is self-synchronising.

Pressing the 'Sync' button with Comp selected gives fast card synchronising at $15^{\circ} \pm 3^{\circ}$/sec. Complete synchronism is indicated by a small oscillation of the card whilst the button is pressed.

Selected to DG for use as a directional gyro, the compass card can be set as required at $15^{\circ} \pm 3^{\circ}$/sec.(F) or $2^{\circ} \pm 0.2^{\circ}$/sec.(S) in a clockwise (+) or anti-clockwise (-) direction by moving the knob to either side, against a spring.

NOTE: The Sync button may be pressed in flight only when that compass is uncoupled from the autopilot and the aircraft is in level flight at unchanging speed.

DG FLAG. In view when DG selected at compass controller.

FIXED LUBBER. Against which the compass heading is read.

DRIFT INDEX & CONTROL
AUTO SHUTTER. The Drift Index is the heading-error signal datum; displacement between this and either the Steering Index, Track Pointer Head or Tail causes heading-error signals to be fed to the Autopilot and Flight Director.

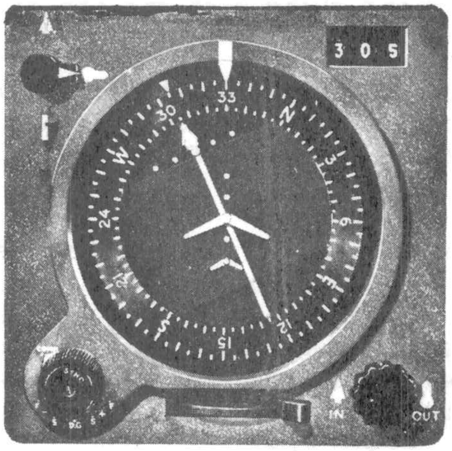


FIG.2 FLIGHT COMPASS
DR MODE

It may be set manually up to 30° either side of the Fixed Lubber by use of the control seen with the Auto Shutter open (Fig.2). There is no automatic setting of the Drift Index; closing the Auto Shutter merely covers the Drift Index Control.

STEERING INDEX. This may be used to command headings regardless of the Radio Coupling Switch position provided a glide path or beam is not coupled. It may be set at any point on, and rotates with the Compass Card. Displacement between it and the Drift Index, causes heading error signals to be fed to the Autopilot and Flight Director; a turn is then demanded until the Steering Index and Drift Index coincide. It becomes inoperative at the beginning of beam capture which on a Localiser is at 4° from the beam centre line and on a VOR, 3.7°.

TRACK POINTER HEAD. This rotates with the Compass Card and may be set at any point round it. It is used, when radio NAV inputs are employed, as an OBS to select a bearing or track with which is compared the radio bearing information being received. Displacement between the bearing selected and the bearing received then produces radio displacement signals which, when the Radio Coupling Switch is at Track Pointer Head, may be fed to the Autopilot and Flight Director.

In addition to demands arising from radio NAV inputs, heading-error signals due to the displacement between the Track Pointer Head and the Drift Index also are fed to the Autopilot and Flight Director.

In the absence of radio NAV inputs, the Track Pointer Head may be used to provide track steering in the same manner as the Steering Index, with manual Drift Index Setting.

TRACK POINTER TAIL. This pointer, as its name implies, remains always 180° removed from the Track Pointer Head. Again, heading error signals arising from the displacement between the Track Pointer Tail and Drift Index may be fed to the Autopilot and Flight Director when it is required to fly the reciprocal of the track selected at the Track Pointer Head.

Cont'd. ...

360° COUNTER. This repeats the selection made with the Track Pointer Head.

The QDM of a VOR beacon may be seen on the 360° Counter by rotating the Track Pointer Head until the VOR TO indication is aligned with it.

SETTING KNOB. This is pulled out and rotated to set the Steering Index, pushed in and rotated to set the Track Pointer Head. In the latter case, the Beam Deviation Scale, Track Pointer Tail and Roller Blind rotates together with the Track Pointer Head.

RADIO COUPLING SWITCH. This switch selects for use either the Steering Index, Track Pointer Head or Track Pointer Tail. Regardless of whether radio NAV inputs are present or not, Track Pointer Head must be selected to employ that pointer.

Radio NAV coupling is precluded when Steering Index is selected but Omnitrack may be coupled in this position.

Track Pointer Tail is selected to fly the reciprocal of the track selected at the Track Pointer Head. The Track Pointer Tail then functions as described, and additionally, reverse radio NAV coupling then takes place to preserve correct left-right sense.

ROLLER BLIND. The various backgrounds, seen in Fig.2, 3, 4 & 5, against which the aircraft symbol on the cover glass is seen, and which are seen in relation to the Beam Deviation Scale and Track Pointer Head, are carried on a Roller Blind. This moves laterally over its rollers to bring into view the relevant presentation as demanded by the selection of an ILS or VOR frequency and by the setting of the Track Pointer Head. On VOR with a setting within ±90° of the QDM, the VOR 'TO' presentation is in view; a setting greater than ±90° presents the 'FROM' mode. The presentation then shows, against the Beam Deviation Scale and Track Pointer Head, the displacement between the bearing or track selected and the bearing received. It shows also, by relationship to the aircraft symbol on the cover glass, the position of the aircraft itself relative to any selected bearing or radio beam.

During aircraft turns, the Roller Blind rotates with the Compass Card, Track Pointer Head and Tail, Beam Deviation Scale and Steering Index; when the Track Pointer Head is being set, it rotates with that. In both cases it may also move laterally whilst rotating.

BEAM DEVIATION SCALE. Against which the Roller Blind representation is seen, this is carried on the same movement as the Track Pointer Head and is fixed in relation to it. In the ILS mode each dot represents $1\frac{1}{4}^\circ$ deviation; in the VOR mode 5°.

GLIDE PATH DEVIATION SCALE AND POINTER. The Glide Scale is engraved on the cover glass and fixed as shown in Fig.3. The Glide Path Pointer appears when the glidepath signal is received.

Movement of the Glide Path Pointer over the Glide Path Scale shows the demand arising from deviation from the glidepath. The relative positions of the aircraft symbol and the Glide Path Pointer shows the statement of the situation.

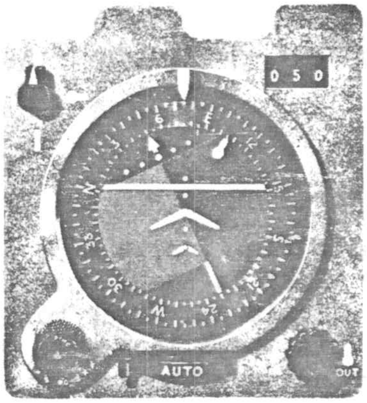


FIG.3 ILS MODE

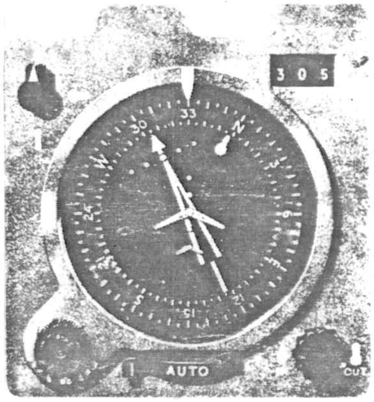


FIG.4 VOR 'TO' MODE

Fig.3 shows the Roller Blind in the ILS mode with the aircraft in the centre of the 050° (M) localiser beam, below the glidepath, with 25° of port drift laid off.

Fig.4 shows the Roller Blind in the VOR 'TO' mode with the aircraft on the 305° QDM and 25° of port drift laid off.

The DR mode, seen in Fig.2 is presented when the FCS Radio Input switch is selected OFF. The Roller Blind should not then move from side to side.

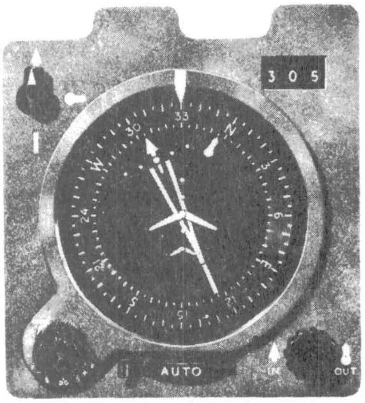


FIG.5 shows the Roller Blind in the VOR 'FROM' mode, on the 305° (M) radial, with 25° of port drift laid off.

FIG.5 VOR 'FROM' MODE

COMPASS COMPARATOR W/LT. Amber, on the port instrument panel. Provided neither compass is selected to 'DG' and the aircraft is not turning at more than 15°/min, their heading indications are continuously compared. If a disagreement of 5° or more exists for more than 45 seconds, the warning light comes on and an amber MWS warning is given. The 45 seconds delay allows for transient discrepancies which may arise during sustained turns or yaw disturbance.

COMPASS TRANSFER sockets. Panel RA. Transposing the plugs at this point allows the RMI cards, 1 & 2 NAV Systems and Omnitrac to take their heading signals from the Port Compass in the event of failure of the Stbd. Compass. Heading for the Flight Recorder would then be lost.

ATTITUDE & FLIGHT DIRECTOR SYSTEMS

ATTITUDE SYSTEM. The Attitude System provides pitch and roll attitude displays for both pilots, and attitude information for other systems. It employs:-

3 Vertical Gyros (VG) -
1 Attitude Comparator -
2 Attitude Director Display Amplifiers -
2 Attitude Directors.

VG1 provides pitch and roll information for the attitude display on the port Attitude Director and also for the Autopilot.

VG2 provides pitch and roll information for the attitude display on the starboard Attitude Director and also for the autopilot Pitch & Azimuth Monitors.

VG3 provides pitch and roll information for the Attitude Comparator, Flight Director and Weather Radar, and pitch only for the Flight Recorder.

Attitude Comparator. This compares, each with the others, pitch and roll signals from VG3 and those repeated back from both Attitude Directors to detect the odd one out. If a fault is found in either instrument, its Attitude Failure Flag shows as detailed below.

If VG3 or the Attitude Comparator itself is faulty, both Flight Director Failure Flags will show as detailed below, both Attitude Failure flags might show and attention will be drawn by the FD ATT warning lamp -

FD ATT warning lamp. Amber, mounted on the port instrument panel, this comes on if VG3 or the Attitude Comparator fails. Failure of VG3 would fail the Flight Director; failure of the Flight Director for any other reason would not bring on the light. The lamp is connected to the amber MWS.

Attitude Director Display Amplifier (2). Circuits in this and the Attitude Director form the servomechanism which operates, in response to signals from the VG to control the roller blind attitude display in the Attitude Director.

It also handles Flight Director signals from the Steering Computer via the Interface Unit.

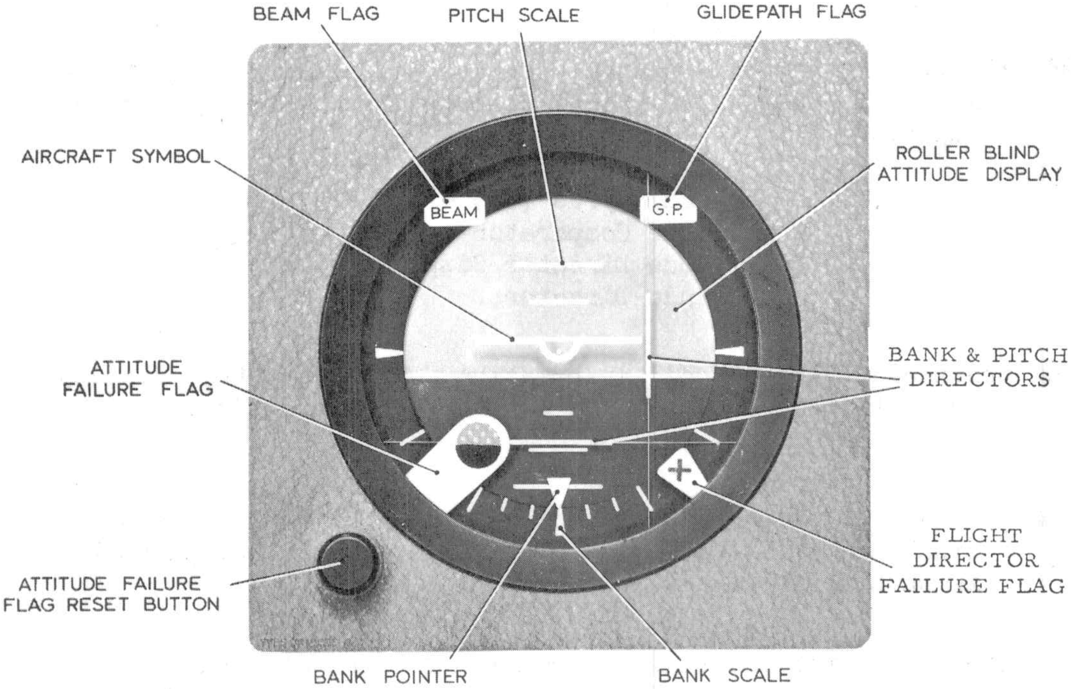


FIG.1 ATTITUDE DIRECTOR

ATTITUDE DIRECTOR. The Attitude Director replaces the conventional artificial horizon and additionally presents Flight Director information by movement of the Flight Director Index over the display.

Fig.1 shows the instrument with the presentation abnormally disposed and the various movements etc. annotated. These are:-

ATTITUDE DISPLAY. Attitude is presented on a roller blind which moves over its rollers across the face of the instrument to show changes in pitch, and rotates to show changes in roll. The pitch scale, representing 10°, 20° and 30°, is carried on the roller blind and is seen against the aircraft symbol fixed on the inside of the outer glass and against the centre mark on the front of the inner glass. Fig.2 shows the display in level flight with the horizon appearing as a white line separating the lower, dark grey, and upper, light grey, semi-circles.

BANK POINTER
BANK SCALE. These provide conventional indication of bank angle. The bank angles shown are 10°, 20°, 30° and 60°.

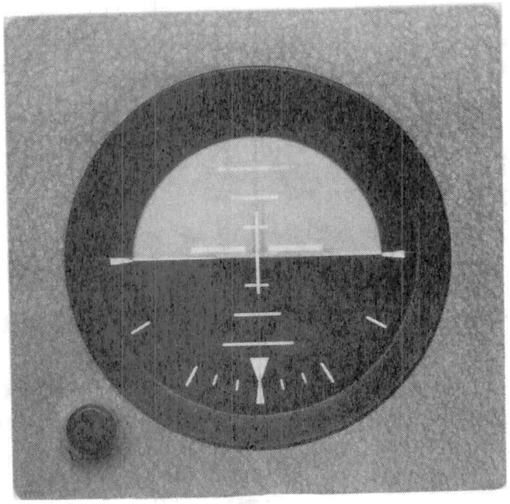


FIG.2 ATTITUDE DIRECTOR

ATTITUDE FAILURE FLAG.
ATTITUDE FAILURE FLAG RESET BUTTON. The Attitude Failure Flag will remain in view after initial switching on. After two minutes, provided gyro erection is complete and there is no unserviceability, the Attitude Failure Flag may be cleared by pressing and releasing the Reset Button. Thereafter, the flag will appear if the attitude display on one Attitude Director differs from that on the other and the attitude signals to the Flight Director:-

In level flight, 5° pitch or roll.
With 30° bank, 5° pitch or 7° roll.

BEAM & G/P FLAGS. With the FCS Radio Input switch to NAV 1 or 2, a VOR or ILS localiser frequency selected at the NAV Controller and a satisfactory signal being received, the BEAM flag (and GP flag on ILS) shows steadily.

If the signal fails or becomes unsatisfactory, in the VOR mode the BEAM flag will disappear; with GP Auto or Man selected, in the ILS mode the BEAM and/or GP flags will pulse.

FLIGHT DIRECTOR. The Flight Director provides a visual monitor of demands to the Autopilot, and presents demands to the pilot in manual flight, arising from all modes of operation except IAS, Height and Acquire Height locks. Control switches, Az Master and F/Dir, are covered in the description of the Flight Controller. It employs, in addition to the units already mentioned, the two remaining movements in the Attitude Director and:-

F/Dir Pitch control -
Steering Computer -
Interface Unit.

FLIGHT DIRECTOR INDEX. The Pitch Director is a horizontal wire which moves vertically, the Bank Director is a vertical wire which moves horizontally; their intersection is referred to as the Flight Director Index. Demands arising from heading - error, radio displacement or attitude, or a combination of any or all these, are shown by movement of the Flight Director Index over the attitude display. The aircraft may then be flown so as to follow the Index and position the datum, the centre of the aircraft symbol, on it. This will place the aircraft into an attitude which will follow the demand signal. As the demanded heading or attitude is approached, the demand signal will diminish and if the Index and datum are kept coincident the manoeuvre will conclude with the aircraft at the new heading or attitude.

FLIGHT DIRECTOR FAILURE FLAG. The flag on both instruments will be in view with the Pitch & Bank Directors -

Parked

If the F.Dir switch goes off due to -

The Az Master switch going off or -

3 VG failure or -

Attitude Comparator failure or -

Either pitch director hitting the stops.

Not Parked

If the Beam or GP signal becomes unsatisfactory or fails or -

If the Compass Comparator warning light comes on or -

If the port and stbd Flight Director demands differ.

F/Dir Pitch control. Mounted on the pedestal, this allows manual positioning of the Pitch Director to present 0 to 15° of pitch up or 0 to 5° of pitch down demand, except when coupled to a glide path.

Steering Computer. Flight Deck rack. This takes attitude signals from VG3 and the F/Dir Pitch control, heading error signals from the selected Compass and radio deviation signals, singly or collectively, and processes them into demand signals. These signals are finally taken after further modification to the Pitch and Bank Directors.

The unit is self monitored and will also detect the lack of a signal required for the selected mode. Either fault will cause the Flight Director Failure Flags to show.

Interface Unit. This is fully described elsewhere. Flight Director signals are processed in this unit to counter incompatability between systems. They are also taken to comparators in which demand signals, and position signals fed back from the Attitude Director Amplifiers, are monitored. Any difference between these or between the presentation on each Attitude Director causes the Flight Director Failure Flags to show.

FLT SYSTEM GYROS switch. On panel P, this controls the single phase 115v AC supply to VG1, 2 & 3.

AUTOTHROTTLE SYSTEM

GENERAL. The Autothrottle System provides the 'Throt' speed lock and autoflare power control by controlling both throttle levers. Engagement is possible at any speed up to 350 kts IAS. Below 165 kts IAS full power is available. At 165 kts IAS and above, limit switches prevent the throttles from opening beyond approximately the recommended climb power setting.

Monitoring circuits protect the aircraft from faults which might cause hardover demands or control, by disengaging the system with appropriate warning.

All the system controls, except the Cut-Out Buttons, are featured in the Flight Controller.

In addition to units mentioned elsewhere the system employs:-

A Computer/Amplifier -
One Actuator -
Two Cut-Out Buttons

COMPUTER/AMPLIFIER. Mounted on shelf 5, electronics bay, this is a twin channel unit having circuits for error signal processing, amplification and auto-monitoring. The error signal arises from the difference between the actual airspeed and the speed set with the 'Select Speed' control. This signal is processed into a demand signal which is fed to the Actuator. A duplicate demand signal is produced in the monitor channel.

At 50 ft radio height, on a Cat.2 approach with an autoflare computer fitted, flare is initiated and the demand signal derived from the error signal is replaced with one which will close the throttles at 5^{o}/sec.

Comparator circuits operate to put off the Speed 'Engage' switch and flash the Mode Indicator if ADC power fails, or when the difference between the demand and monitor signals exceed 4 kts and the deviation occurs at a rate exceeding 1 kt per second. If the rate of deviation is less than 1 kt per second, a disconnect may not occur. A clutch monitoring circuit produces the same result if the Actuator clutch current varies by ± 50%. The Mode Indicator flashes also when putting the 'Engage' switch off with 'Throt' engaged. After glide path capture, a red MWS warning is also given in these events. The flashing is cancelled by pressing the Autothrottle Cut-Out Buttons.

ACTUATOR. This employs the demand signal from the Computer/Amplifier to drive a servomotor. This shaft rotation is taken through a gearbox to two electro-magnetic clutches through which the torque is transmitted to the throttle levers.

CUT-OUT BUTTONS (2). Mounted one on each throttle lever, pressure on either one, or both, disengages 'Throt' lock without any indication except for the disappearance of 'THROT' on the Mode Indicator.

If the 'Throt' lock is disengaged by putting off the 'Engage' switch or selecting 'Kill' at the 'Auto Throttle' switch, the buttons will still have to be pressed to cancel the Mode Indicator and MWS flashing.

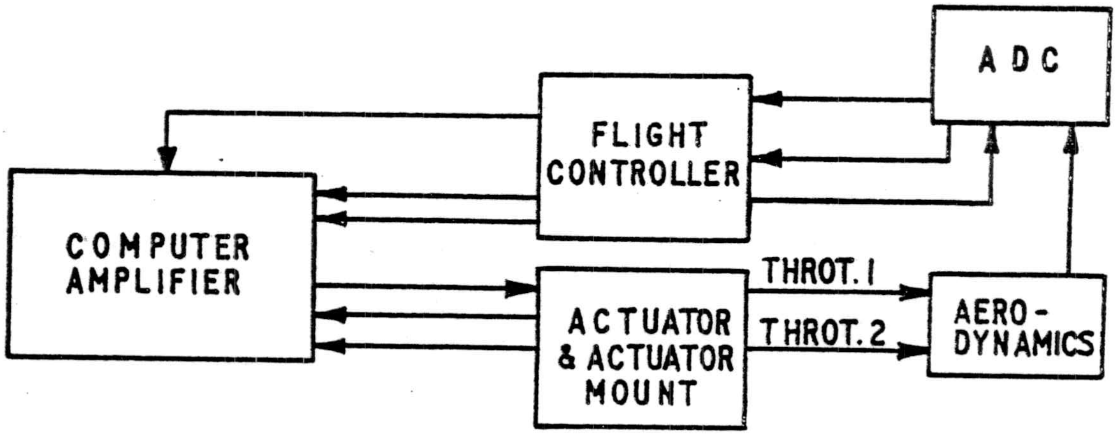


FIG.1 AUTOTHROTTLE SYSTEM

RADIO NAV SYSTEMS

GENERAL. Independent, identical twin systems for the reception of VOR and ILS LOC & GP are provided by two complete Collins 51RV-2B installations. These are NAV 1 and NAV 2. Two Marconi AD 260 marker beacon systems, MKR1 and MKR2, complete the ILS requirement.

The systems incorporate:-

2 Controllers
2 FCS Radio Input switches
2 VOR/ILS Receivers

2 Marker Aerials
2 Marker Receivers
1 Glide Path Aerial
1 VOR/LOC Aerial.

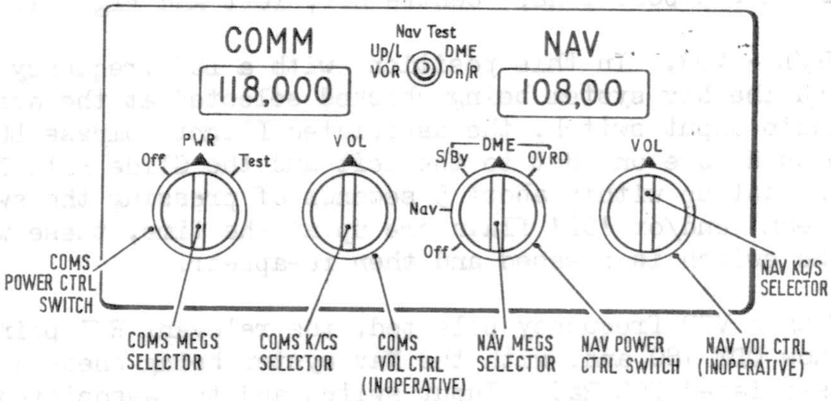


FIG.1 VHF COM/NAV CONTROLLER

CONTROLLER. Two combined VHF Com/Nav Controllers are mounted on the pedestal, NAV 1 port. Fig.1 shows the controls and most of their functions. The Nav side of each Controller allows selection of 200 channels, with 50 Kc/s spacing, within the band 108 - 117.95 Mc/s and a further 60 channels, with 50 Kc/s spacing, within the band 133 - 135.95. The latter band allows reception of unpaired (with VOR) DME stations. A shutter covers the megacycles digits whilst the megs selector is being rotated from 118 to 132.95. Selection of a LOC frequency on Nav 1 or 2 automatically selects also the paired GP frequency. Selection of a VOR frequency on Nav 1 or 2 automatically selects also the paired DME. Further contacts on the frequency selector switches determine the display, VOR or ILS, on the Flight Compass.

Nav Power Ctrl Switch. Marked Off, Nav, Stby, DME, Ovrd.

Off - All power off.

Nav - Nav system power on. This remains on in all positions except 'Off'.

Stby -)
DME -) See DME
Ovrd -)

Nav Test switch. This allows self-testing of VOR, ILS and DME circuits and has 3 positions; centre off, left and right as follows:-

UP/L - VOR. In this position, with a LOC frequency selected and the Nav system being checked selected at the associated FCS Radio Input switch, the associated Flight Compass LOC presentation should move one dot to the left and the Glide Path Deviation Pointer one dot up within about 5 seconds of pressing the switch. If the 'Beam' and/or 'GP' flags are up at the time, these will clear when the switch is pressed and then re-appear.

With a VOR frequency selected, the relevant RMI pointers should show QDM 180 and, with the Nav system being checked selected at the associated FCS Radio Input switch and the associated Compass Track Pointer Head set on 180, a VOR 'TO' presentation should be seen. If the BEAM flag is up at the time, it will clear and then re-appear.

DME - DN/R. Similar to above in regard to ILS except that the presentations move one dot right and down respectively. The DME function is covered in the DME description.

FCS RADIO INPUT switches. Two, mounted one on each port and starboard instrument panel and marked Off - Nav 1 - Nav 2, these control the input to the FCS. The port switch selects Nav 1 or 2 to the port Flight Compass, the starboard switch selects Nav 1 or 2 to the starboard Flight Compass. With the same Nav system selected on both switches, the Track Pointer Head of the selected (Port or Stbd) Compass is the controlling OBS and will vary the presentation on both Flight Compasses.

VOR/ILS RECEIVER. Two, mounted on shelf 3 of the flight deck radio rack. This unit incorporates four sub assemblies as follows:-

VHF Nav Receiver. This receives VOR and LOC signals within the band 108 - 117.95 Mc/s, and holds system self-testing circuits.

Glidepath Receiver. This receives glidepath signals within the band 329.3 - 335 Mc/s, processes them and provides glidepath deviation and GP flag outputs to the FCS.

VHF Synthesiser. This controls the VHF Nav Receiver frequency and tuning.

VOR/LOC Instrumentation Unit. This takes VOR or LOC signals from the VHF Nav Receiver, and track selection and magnetic heading signals from the FCS. It produces VOR or LOC deviation signals, VOR TO/FROM signals and BEAM flag signals for the FCS. It also produces VOR relative bearing signals for the RMI pointers.

MARKER RECEIVER. Two, mounted on shelf 3 of the flight deck radio rack. This operates on a fixed frequency of 75 Mc/s and provides reception of ILS and airways fan markers. Output is presented aurally on selection of MKR1 or MKR2 at Station Boxes, and visually on three lamps labelled AIRWAYS (White), MIDDLE (amber), OUTER (blue), MKR1 port instrument panel, MKR2 starboard. A HI/LO switch for each system is mounted directly beneath the associated lamps. HI for cruise, the LO position attenuates the receiver for ILS markers.

The systems are supplied whenever Radio 1 & 2 DC Bus Bars are energised; there are no power control switches.

PRESENTATION. The six instruments concerned with the display of information from NAV1 & NAV2 are:-

Two Flight Compasses
Two Attitude Directors
Twin RMI

The presentation on the Flight Compasses is covered in the Compass System, that on the Attitude Directors in the Attitude and Flight Director Systems. RMI's are featured in the ADF System.

AERIALS. Both NAV systems share the VOR/LOC aerial either side of the fin and the glidepath aerial in the radome. Marker aerials are in the mid lower fuselage, MKR1 foremost.

POWER SUPPLIES. These are shown in Power Supplies & Cooling.

DME

GENERAL. Two Collins 860E-3 installations form identical twin Distance Measuring Systems capable of providing indications of slant range up to 390 nm from the VOR/DME, Vortac or Tacan station being interrogated.

Except for the aural call-signs of the ground stations, received with NAV 1 or 2 selected at the Station Box, information from the two systems is presented on a dual Indicator (Fig 1).

Accuracy is claimed to be ± 0.1 nm on ranges up to 5 nm with aircraft speed 200 kts or less. On ranges 5 - 380 nm and speed up to 2000 kts it is ± 0.2 nm.

CONTROLLER. This is featured in the Radio Nav Systems description where it is shown that selection of a VOR frequency selects also the paired DME channel. Switch positions not fully covered there are:-

STBY - Receiver on, four dashes on Indicator, ready for full operation in one minute.

DME - Range limited to 200 nm.

OVRD - Override. Maximum range.

If DME or OVRD is selected from cold, the one minute delay still obtains.

NAV TEST switch. With the system warmed up and a DME channel selected, the switch is operated momentarily to initiate the self-test function. If the system is serviceable the Indicator goes blank for one second, followed by four dashes for one second and finally four zeros for ten seconds. If the system is unserviceable the indicator will remain blank.

If an RCA AVQ70 DME unit is fitted in place of the Collins, 094.0 (±1) will be shown instead of 000.0.

DISTANCE INDICATOR. A dual Indicator is mounted centrally above the coaming. This may show from 000.0 up to 399.9.

The digits are constructed of straight light bars. Any digit, except the hundreds, will be completely extinguished if a fault on a horizontal bar would otherwise cause an incorrect figure to be presented. At Stby and when no information is available, e.g. if the ground station is inoperative or out of range, a dash is presented in place of each digit. With power off or system failure, the Indicator goes blank. The knob controls digit brilliance.

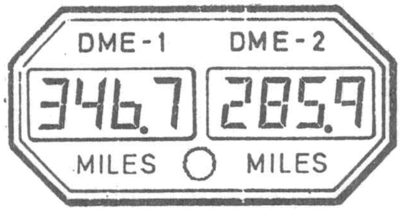


FIG.1 DISTANCE INDICATORS

DME UNIT (2). These are carried in the electronics bay and may provide 252 channels. The transmitter frequency is 1025-1150 mc/s, the receiver 962-1213 mc/s.

AERIAL (2). Mounted on the lower fuselage, No.1 foremost.

POWER SUPPLIES. Shown in Power Supplies and Cooling, 115V single phase AC controlled by a 28V DC relay for each system.

DME - OPERATIONAL

TACAN This has a DME plus a radio nav system which latter is not useable by BEA aircraft. The Nav controller frequency to select to obtain the DME channel is shown in the 'VOR/Tacan Frequency/Channel Pairing' table in the Europe Supplement to the Flight Guide. Selection of a Tacan DME could result also in reception and presentation of bearings from some unwanted VOR.

VORTAC This is a Tacan station plus VOR. The VOR and DME frequencies are paired, e.g. 116.7/Chan 114. The above table shows 116.7 Mc/s selects DME channel 114.

VOR/DME Listed thus they have a common call-sign and paired frequencies and are co-located. E.g. Prestwick VOR/DME PWK 117.5/Chan 122.

CALL-SIGNS Where the VOR and DME stations are not co-located they have different call-signs. DME call-signs are radiated at 30 second intervals on a higher note than that of the VOR call-signs.

NOTE: It is possible to receive two DME stations simultaneously when they are more than 100 nm from the aircraft. The only indication of this is garbling of the call-signs. The range of the stronger signal is presented normally.

RADIO ALTIMETER SYSTEM

GENERAL. The Bendix ALA.51A Radio Altimeter System provides an indication of aircraft height up to 2500 ft above the surface beneath, indication of descent through a given height, and height outputs for the FCS. The latter are employed as switching signals, and as height signals to the flare computer for pitch attitude control, in Cat.2 approach. The system also provides a height output for GPWS.

Accuracy is ±2 ft or 2% of the indicated height within the range 0 to 500 ft., ±5% within the range 500 to 2500 ft.

In the event of a failure in the system, self-monitoring circuits operate to:-

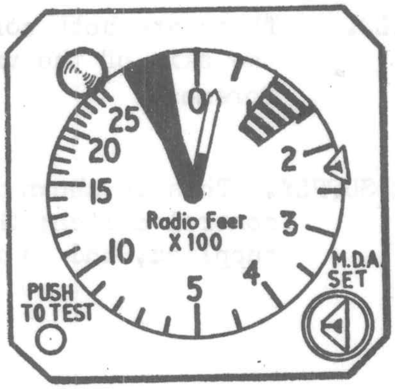
Stop the pointers momentarily -
Open the Radio Altimeter interlock -
Show the fail flags -
Then drive the pointers out of sight behind the masks off the scale.

With 'Prime Land' selected, (Cat 2) opening the Radio Altimeter interlock will cause an Autopilot auto-disconnect.

The system employs:-

Two Radio Altimeters -
A Radio Altimeter Tx-Rx Unit -
Two aerials.

RADIO ALTIMETER. Two, mounted one in each port and starboard instrument panel. These are calibrated, as shown in Fig.1, linearly to 480 ft then logarithmically to 2500 ft., and carry a pointer, a mask, two controls, a moveable index, an amber lamp and a red/white flag.



Above 2500 ft the pointer is concealed behind the mask and the flag is unseen.

Push To Test button. If the system is serviceable when the button on either instrument is pressed, the pointer goes to 30 ft. and the flag shows, as seen in Fig.1, on both instruments.

Amber Lamp.
MDA Set control. The control sets the (minimum decision altitude) index at any point round the dial. On descending through the set height, the dimmable amber lamp comes on and will remain on whilst the aircraft is below the set height. It will be seen that the index must be set below zero to put the lamp out on the ground.

RADIO ALTIMETER Tx-Rx UNIT. Mounted in the electronics bay, this incorporates the transmitting, receiving, processing and self-monitoring circuits of the system.

The principle of operation is simply that a transmission of continuously varying frequency, 4200 to 4400 Mc/s, is directed towards the surface and reflected back to the receiver. The distance the wave has travelled (twice the aircraft height) is calculated from the difference between the frequency being transmitted and that being received back at any instant.

AERIALS. These are both cone shaped, mounted with their open ends flush with the skin of the under fuselage, 20 inches apart, transmitter aerial foremost.

POWER SUPPLY. This is shown in Power Supplies & Cooling. There is no power control switch; the system is energised whenever Radio 1 AC Bus is supplied, and is immediately operative.

OMNITRAC NAVIGATION SYSTEM

GENERAL. The Omnitrac Navigation System is based on the Omnitrac 2B Computer. This may accept a variety of inputs from navigation data sources, from which it produces the required outputs. The main input is Harco (Hyperbolic Area Coverage) which is a development of the Decca Navigation System using Decca signals. Provision is made to use VOR/DME inputs from NAV1 & 2 but this is not available at present. The system provides:-

Constant indication of position on an orthomorphic chart -

Indication of relative bearing and time or distance to any selected position (Way Point or Ghost Beacon) -

Integration with the FCS with drift indication when coupled to the Autopilot -

Information storage providing DR support whilst chart or Chain changing, selecting a Way Point or Ghost Beacon, or whilst reception is inadequate. A Way Point is a position to which the aircraft is going when coupled; a Ghost Beacon may be on or off track.

Automatic Chain selection -

With a route number inserted, automatic chart selection and an automatic sequence of way points from beginning to end of a route.

Fixes may be taken from the Flight Log chart or the Relative Bearing Indicator and Distimeter. Once the system has been started within plus or minus half a Zone of the correct position, all ambiguities arising from recurring Zones are automatically resolved.

The DR facility is based on a continuous input of heading from the starboard Flight Compass, IAS from the FCS Air Data Computer, altitude from the starboard servo altimeter with assumed ISA temperature for TAS, and a stored wind vector produced from the last Decca signals.

The units with which pilots are concerned are:-

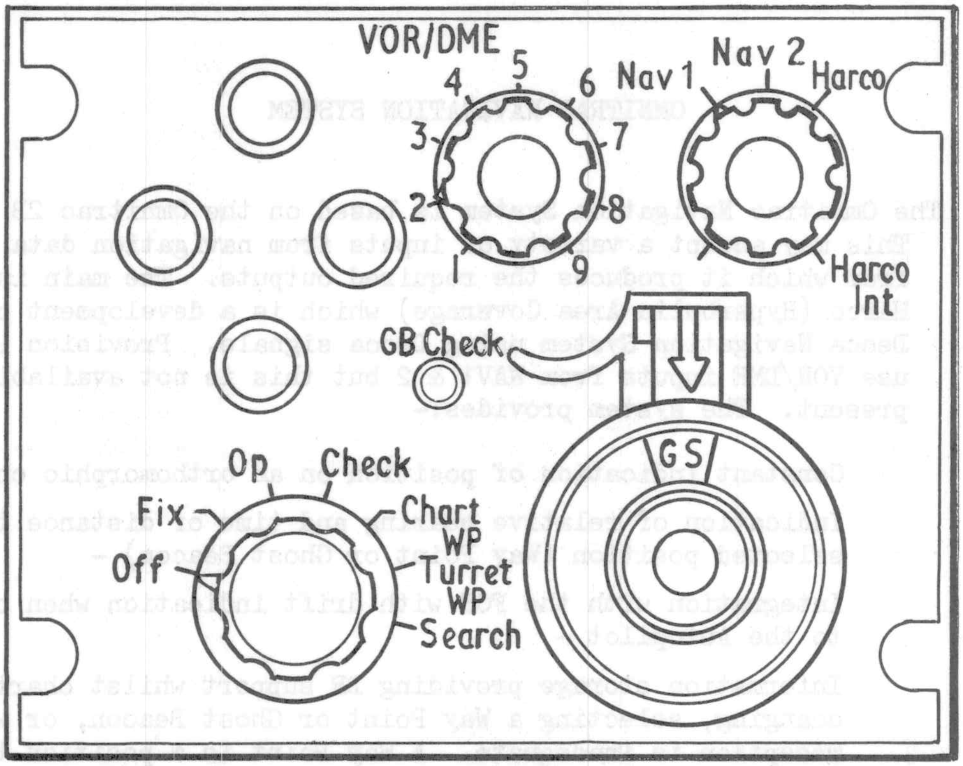


FIG.1 FLIGHT LOG CONTROLLER

FLIGHT LOG CONTROLLER. This is mounted on the pedestal and carries controls (see Fig.1) as follows:-

Function Switch. This operates conventionally through detent positions except on being moved from 'Op' to 'Fix' when the knob must be pulled out before rotation. This prevents unintentional selection of Fix or Off with the consequent loss of stored information.

Off - All power to whole system off.

Fix - Allows manual positioning of chart and cursor to define a position for insertion into computer. It also allows insertion or alteration of route numbers and, by chart change or pressing the GB Check button, cancellation of auto sequence. The Route number is shown whenever Fix is selected.

Op - Normal operating position in which the aircraft position is shown on the chart.

Check - This allows a check of Way Point or Ghost beacon positions. Normal operation, as in the 'Op' position, continues until the WP1, 2 or 3 button or 'GB Check' button is pressed whereupon the selected Way Point or Ghost Beacon position is indicated by the cursor on the chart. Also, the relative bearing of and distance to or time to reach the position is presented on the RBI and Distimeter provided that GB is selected at the Distimeter and that the GS key is inactive.

In the meantime, if the aircraft is moving, its track made good goes into store. On switching from 'Check' back to 'Op' the cursor returns to the point from which it was taken when WP1, 2, 3 or 'GB Check' was pressed, and then catches up with the aircraft.

'Check' also allows presentation on the Flight Log of the un-updated position (if any) in the Decca receiver, by use of the Update Button, but without updating. The prospective course change can thus be seen before the demand is allowed to go to the Autopilot on updating.

Chart WP - This is used to define Way Points on the chart. Any chart may be selected, and the cursor ring placed on the required position. WP1 button is then pressed until its lamp lights to show that the position has been stored. This procedure may be repeated for WP2 and 3.

As the cursor and chart auto-drive is inoperative in this switch position it may also be used to bring any part of the chart roll into view. On return to 'Op', the presentation returns to the position from which it was taken and then catches up with the aircraft.

Turret WP - This is used, with WP3 button, only to remove WP3. Op must be reselected between each deletion of WP3.

Search - This allows a Ghost Beacon to be defined from the chart. Any chart may be selected, and the cursor ring placed on the required position. 'Op' is then re-selected whereupon the position is taken into storage; simultaneously the presentation automatically returns to the position from which it was taken and then catches up with the aircraft, if necessary, chart or chain changing all from information stored whilst 'Search' was selected. At any time thereafter, this chart Ghost Beacon will be activated whenever the GS key is not in the active position. It may be seen that the absence of the Turret would not affect this facility.

GB Check button. This allows a display of ghost beacon positions in the 'Check' position of the Function Switch. See above. It will also cancel the auto sequence and bring the route number to 000.0 if pressed whilst the Function Switch is at 'Fix'.

Turret. One permanently installed Turret holds one key marked GS. To activate this the adjacent lever (see Fig.1) is depressed and the Turret rotated to bring the key beneath the arrow.

With the Function Switch at Op and provided that the IAS is above 100 kts, ground speed is then presented on the Distimeter.

Chart/Cursor Control Buttons. The upper and lower buttons are for chart control, the left and right for cursor & stylus. First pressure gives slow movement, second pressure faster. These would normally be used in the 'Fix', 'Chart-WP' or 'Search' positions of the Function Switch. If they are pressed with the Function Switch at 'Op', the cursor and/or chart will return to the correct position when they are released.

Sensor Selector Switch. This selects the source of signals used for the Flight Log Display head and has positions Nav 1, Nav 2, Harco, Harco Int as shown in Fig.1. Nav 1 and Nav 2 may be disregarded.

Harco - In this position the normal Decca/Harco signals with auto Zone identification are used.

Harco Int (egrate) - This is used in fringe areas where the Zone identification may be unreliable. The Computer derives the output to drive the Flight Log by adding successive counts of Zone fractions to a co-ordinate set in from the Flight Log at a known fix.

Update Button. Centre of Sensor Selector Switch. This is used as featured in the Check position of the Function Switch and in the description of the Flight Log amber lamp indications.

VOR/DME switch. This switch and its central press-button may be disregarded.

ZONE IDENT METER (Fig.2). Mounted on the starboard instrument panel.

The automatic Lane setting process in the Harco receiver resolves all ambiguities within any one Zone as in Mk 10 Decca. Ambiguities between a number of Zones are resolved by the integrating action of the Computer and Flight Log provided the system has been started correctly within plus or minus half a Zone. That is, within ± 2.85 nm at the narrowest part of a Zone, which allows a tolerance of ± 0.36 ins. on a half million chart in the worst possible case.

The meter provides an indication of any discrepancy between the transmitted Zone identification information and the Computers' Zone count and may be used to resolve doubts on entering an area of Decca cover. Its continued operation also provides a regular indication of serviceability of much of the receiver.

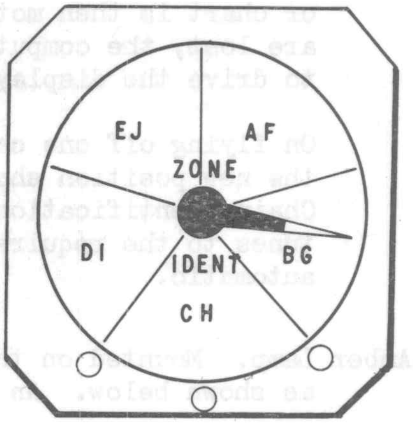


FIG.2 ZONE IDENT METER

The three apertures below the meter dial hold red green and purple lamps which are lit together as, at 20 sec intervals, the ident cycle starts. At this moment, if the transmission is satisfactory, the pointer should indicate within ± 2 divisions of 360°. The lamps go out again then come on singly as, with 2½ seconds between each colour, the associated pattern Zone ident signals are transmitted in the order red, green, purple, and the pointer indicates the Zone letter on which the aircraft lies. It will be seen that of the two Zone letters on the meter only one can be right. The Zone letter indicated should agree with the letter marked on the chart. If it does not, the cursor must be correctly positioned manually.

Zone identification transmissions are no longer made for the French chain and Zone boundaries are not now shown on the charts.

FLIGHT LOG DISPLAY HEAD. Mounted in the Centre instrument panel this may contain up to 70 ft of route and approach charts printed on a translucent plasticised material. A transparent cursor marked with a small circle and centre dot indicates the position on the chart.

The chart projection is Zenithal Equidistant so a straight line drawn on it represents a great circle, and bearings will be correctly represented. The scale will generally be 1:1,000,000 for route charts and 1:500,000 for approach except for UK charts which are mostly 1:500,000. The system can use scales within the limits 1:32,000 to 1:8,000,000. One edge of the chart material carries the digit tracks featuring the various items of information which are read into the computer. Against the chart itself, position information, against the spaces between the charts, details of chart scale and angle, variation, chain frequency and type etc. Charts are on two rolls. One roll has all routes to and within Germany plus Amsterdam & Brussels; the other roll all other routes.

The display is driven by a closed loop servo system in which the cursor position on the chart is read into the computer which constantly compares this with the position of the aircraft in the Decca lattice derived from the received signals; the cursor and/or chart is then motored to zero the discrepancy. If Decca signals are lost, the computer then operates in memory mode and continues to drive the display by DR.

On flying off one chart, the next is automatically selected and the new position shown. If a chart is manually selected, the Chain identification is read into the receiver which automatically tunes to the required Chain as it does when the chart selection is automatic.

Amber Lamp. Mounted on the upper edge of the Display Head this operates as shown below. An adjacent button is pressed to test the filament.

On steady	- If chart not read in correctly and during chart change.
Long Flashes	- During initial setting up after chart read in; goes out after 50 seconds. Whilst the system is in DR mode.
Out	- System operating normally.
Short flashes -	

These flashes are at the same frequency but have less 'on' time than the long flashes. They are given to show that there is possibly a discrepancy between the Cursor position on the chart and the aircraft position in the Decca lattice, which will not be automatically zeroed as described above, but which may be zeroed if the Update Button is pressed.

Thus, in the coupled mode, a large demand is not presented to the Autopilot at the times given below, until the updated position has been seen and accepted. This is done by selecting Check at the Function Switch and then holding down the Update Button; the Flight Log will then present the updated position, if any. On releasing the button, the presentation will revert to the un-updated position, if it had moved. Op may then be re-selected and if the updated position is acceptable, or if there was no Cursor movement, the Update Button pressed again to update and clear the flashing light.

The short flashes are given as follows -

With the system operating normally, that is, Decca signals being received, the F. Log Controller at 'Harco' and 'Op' and the Omnitrac/FCS Controller at 'off' or 'Harco', onset of a certain fault condition causes the F.Log Display Head amber lamp to give short flashes. If no action is taken, the flashing will stop when the fault condition disappears, and the correct position will be presented.

Short flashes will be given also at the following times:-

Approx one minute after selecting 'Op' -
Approx one minute after changing Chain -
Approx one minute after switching from 'Harco Int' to 'Harco' -
On changing slave pair in use -
After (not during) loss of Decca signals.

This flashing can be cancelled only by pressing the Update Button as detailed above.

If the fault condition were to arise during one of the above five occasions and the Update Button was pressed, the short flashing would change to normal long flashing (1 sec on, 1 sec off) continue for approx one minute then revert to short flashes. If the fault had now cleared, pressing the button again would stop the flashing. If it had not, the same cycle of normal and short flashes would be repeated, requiring the button to be pressed yet again.

DISTIMETER. Mounted on the port instrument panel this has controls and digital presentation as shown in Fig.3 and may indicate either :-

Route number -

Ground speed -

Distance in nm or -

Time in minutes to reach either WP1 or the selected Ghost Beacon as determined by two switches detailed below.

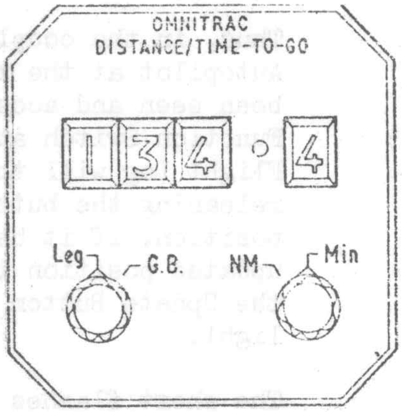


FIG.3 DISTIMETER

Route number is initially set in the Distimeter by use of the WP buttons with Fix selected at the Function Switch. Thereafter, whenever Fix is selected, the route number is shown.

Ground speed is presented in the Distimeter when the GS key is set beneath the arrow and Op is selected at the Function Switch.

Leg/GB switch. At Leg, the distance or time refers to WP1; at GB it refers to the selected Ghost Beacon. The switch also determines to which point the RBI is referring.

NM/Min switch. This determines whether distance or time is presented. As the digits may show only up to 999.9, distances beyond 1000 nm are shown as the number in excess of 1000.

RELATIVE BEARING INDICATOR. Mounted on the starboard instrument panel this is simply a fixed 360° scale traversed by a pointer which indicates the relative bearing of the point selected at the Leg/GB switch of the Distimeter.

It will be seen that as drift is automatically laid off when coupled to the Autopilot and flying from Way Point to Way Point, the drift-angle is also presented.

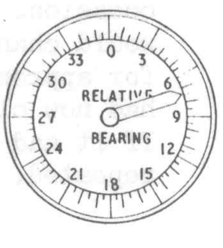


FIG.4 RELATIVE BEARING INDICATOR

OMNITRAC/FCS CONTROLLER. Mounted on the pedestal this unit (Fig.5) is concerned only with the Omnitrac/FCS coupled mode, except for the 'Dim' control which varies the WP buttons and red lamp brilliance. Other controls are:-

Sensor Selector Switch. Marked Nav, Off, Harco as shown in Fig.5, this determines which system is used by the computer to produce the input, and controls its coupling to the FCS (Autopilot & Flt Director). It has no control over the F.Log Display Head. The 'Nav' setting concerns VOR/DME and may be disregarded. VOR/LOC input is controlled at the FCS Radio Input Switches as featured in the Radio Nav Systems section.

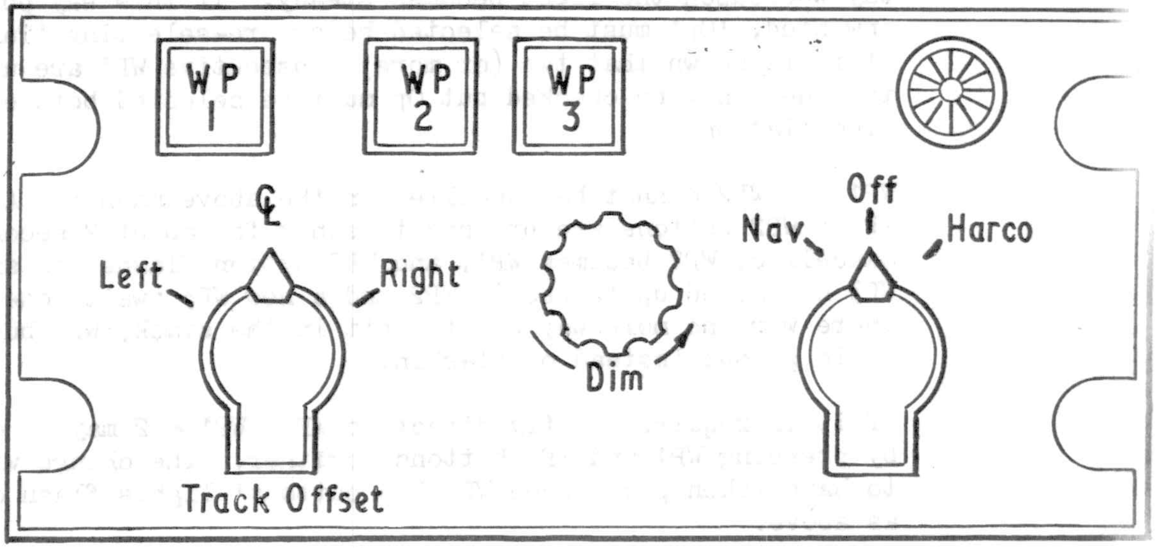


FIG.5 OMNITRAC/FCS CONTROLLER

WP1 WP2 WP3 buttons. These are employed, as detailed in Management to -

- Insert route numbers -
- Check way points -
- Remove way points -
- Transfer way points -
- Establish way points -
- Indicate transit of way points.

/Cont'd. ...

Route Number Insertion. For automatic way point sequence. At 'Fix', for every 120 milliseconds the buttons are pressed -

WP2 increases the number by 1

WP1 increases the number by 10

WP3 & WP2 together decrease the number by 1

WP3 & WP1 together decrease the number by 10

Way Point Checking. See 'Check' position of Function Switch.

Way Point Removal From Automatic Sequence. With 'Turret WP' selected, pressing WP3 button cancels WP3. The button's light then goes out if there are no more way points,or flashes to show that a new WP3 has come from the stack. This may then be checked in the usual way whereupon the light becomes steady. If this way point also is unwanted, 'Op' must be selected before re-selecting 'Turret WP'. If it is known that two (or more) consecutive WP3 are unwanted, they need not be checked but Op must be selected between each cancellation.

WP1 and WP2 cannot be cancelled in the above manner. At 'Op', if WP1 & WP2 buttons are pressed together for about 2 seconds, WP1 is cancelled, WP2 becomes WP1, and WP3 button flashes to show that WP3 has moved up to become WP2 and a new WP3 awaits checking. If there were no more way points left in the stack, WP3 button light would go out instead of flashing.

If it is required to fly direct to WP3, WP1 & 2 may be cancelled by pressing WP1 and WP3 buttons together. The change will be seen to have taken place when WP2 & 3 buttons' lights flash or go out, as above.

To by-pass WP2, WP2 & 3 buttons are pressed together to cancel WP2. WP3 light flashing shows that WP3 has moved into WP2 position and a new WP3 awaits checking.

Way points are cancelled and moved up in the same manner when automatic way point sequencing is not being employed. In this case, WP3 button light would go out on cancelling WP1.

Way Point Transfer. It will be seen from the above that cancelling WP1 automatically causes WP2 & 3 to transfer to WP1 & 2 position; cancelling WP1 & 2 puts WP3 in WP1 and so on.

Establishing Chart Way Points. When automatic way point sequencing is not being employed, way points may be established entirely from the chart as described under Function Switch - Chart WP. When auto sequencing is being used, a chart way point may be inserted to replace one from the auto sequence.

Way Point Transit Indication. As the aircraft nears WP1, at a point 0 to 43 seconds flying time from WP1, depending on speed and the required course alteration, the turn (if any) is started (if coupled) and the way points move up one. WP2 now becomes WP1, WP3 becomes WP2 and WP3 button light flashes, in the auto sequence mode, or goes out otherwise.

In the auto sequence mode, WP3 may then be checked whereupon the light becomes steady. If the way point is not checked its function is unaffected. In the non auto sequence mode a new WP3 may be inserted from the chart. If it is not, or if there are no way points left in the auto sequence mode, as the aircraft approaches WP1 (ex WP2) two buttons, WP2 & 3 will be left unlit when the turn is started onto the third leg as the original WP3 now moves up to become WP1. If more way points are not inserted, WP1 button light remains on when the way point is overflown and guidance is continued on the extension of the leg.

Track Offset switch. Marked 'Left' - 'CL' - 'Right'. This allows a track to be made good to the left or right, or on the centre line, of that defined between Way Points. The amount of displacement from the centre line is 3 nm; this is variable in the Computer programme, a number of alternatives being available.

Red Lamp. This operates as follows:-

On steady - Flight Log Controller not at 'Op' and 'Harco'.

Flashing - At switch on and failure to read in a chart.

Out - System operating normally.

AERIAL. This is mounted beneath the skin on the forward lower centre line.

AERIAL AMPLIFIER. Mounted adjacent to the aerial.

RECEIVER Mk 16
OMNITRAC 2B COMPUTER
ANCILLARY UNIT 934/DD2. These are mounted on the top shelf of the hold radio rack.

POWER SUPPLIES. 28V DC and 26V AC as shown in Power Supplies & Cooling.

OMNITRAC MANAGEMENT

GENERAL. The track to waypoint 1 is defined from the aircraft position at the moment of selecting 'Harco' on the Omnitrac/FCS Controller to couple to the Autopilot. If 'Harco' was already selected, it would be from the position in which WP1 button was pressed on inserting the waypoint, or the position in which setting up for auto sequence took place.

If 'Check' is not selected when changing a way point, as detailed in management, all subsequent way points already inserted or in the auto stack, will be lost.

At airfields with a variety of departure routes, the waypoints required to define several routes are combined into one stack thus reducing the route numbers required. For any specific departure, certain unrequired waypoints may be presented from the stack; these must be cancelled as detailed in Management.

WP buttons' lights may go out when expected to flash; the chart change following will start the flash and the waypoint may then be checked.

SETTING UP FOR AUTO SEQUENCE

1. Check Omnitrac/FCS Controller 'Off' -

2. Switch system off if chart roll to be fitted -

3. Fit required chart roll (detailed below)

4. Select 'Fix', wait 5 seconds -

5. Set route number in Distimeter -

6. Select 'Op'. Chart will move (to end of roll and back if 'Off' has been selected, or if the required first chart is not the chart in view). When chart movement stops, check -

   k. Route start presented on Flight Log. If not, see a.
   m. Red light out. If not, see b.
   n. WP buttons flashing. If not, see c.
   o. Amber light long or short flashing. If not, see d.
   p. After up to 90 seconds, amber light long flash becomes short. If not, see e.

7. Press Update Button and check amber light out and aircraft position shown on Flight Log. If not, see f.

8. Select 'Check', see red light on steady then press WP1 button and check WP1 light steady and Waypoint 1 position presented on Flight Log. If not, see g. Repeat for WP2 and WP3.

9. Select 'Op' and check aircraft position shown on Flight Log.

   a. Check correct route number set.
   b. Check Off at Omnitrac/FCS Controller. If flashing, system fault. Switch off and start again.
   c. Check Dim control.
   d. Check Harco selected at F. Log Controller. If light steady, system fault. Switch off and start again.
   e. Check Zone Ident Meter for normal operation.
   f. Suspect poor signal; it may be clear or be cleared later. If flashing persists or if cursor not on correct position, select 'Harco Int'.
   g. If cursor goes to wrong waypoint, check correct route number set.

ROUTE NUMBER CHANGE AT TURN-ROUND

1. Select Fix.
2. Set route number in Distimeter.
3. Select Op. Any WP buttons lit will clear and if the chart required for the start of the route is in view it will move out and then read back in. If the required chart is not in view, the chart roll will be driven to the end and back to the required chart. (In both cases WP1 will be the ramp position; this can be cleared by moving the waypoints up or left to clear itself on departure).
4. When chart movement stops, continue with Setting Up For Auto Operation Items 6k, m, n. The amber lamp may be out or flashing. If it is out, continue with Item 8. If it is flashing, continue at 6p.

ROUTE NUMBER CHANGE IN FLIGHT

1. Check that new route number is available on the chart in view. If not, revert to manual operation. If it is -
2. Select Omnitrac/FCS Controller Off.
3. Select Fix.
4. Set new route number in Distimeter.
5. Select Op. WP1 will remain, WP's 2 & 3 will clear, the chart will move to a set of short constants and back in, loading new WP's 2 & 3. These may need moving up.
6. When chart movement stops, continue with Setting Up For Auto Operation Item 6m & n. The amber lamp may be out or flashing. If it is out, continue with Item 8. If it is flashing, continue at 6p.

WAYPOINT TRANSFER & CLEARANCE

With 'Op' selected, to fly direct to -

WP2 missing WP1 - Press WP1 & 2 together until WP3 button light flashes or goes out.

WP3 from WP1 - Press WP2 & 3 together until WP3 button light flashes or goes out.

WP3 missing WP1 & 2 - Press WP1 & 3 together until WP2 & 3 buttons' lights flash or go out.

To clear WP3 and bring in next waypoint in auto sequence -

1. Select 'Turret WP' -
2. Press WP3 button until light flashes -
3. Select 'Op' and with cursor on aircraft position -
4. Select 'Check' -
5. Press WP3 and see light steady and cursor on new WP3 position -
6. Select 'Op'

Note: A return to 'Op' must be made between successive WP3 clearances.

WAYPOINT POSITION CHECK

1. Waypoint checks must start with Op selected and the cursor on the aircraft position but need not be carried out directly the WP button flashes. A later check may reduce chart movement and improve operation.
2. Select 'Check' -
3. Press WP (1, 2, 3), cursor indicates position and, with the GS key inactive and GB selected on the Distimeter, the relative bearing of and distance to or time to reach the position is presented on the RBI and Distimeter.

CHANGING WAYPOINTS

1. Select 'Check' -
2. Press WP button to be changed, then when cursor moves -
3. Select 'Chart WP' -
4. Position cursor as required
5. Press WP button until light flashes.

TO CANCEL AUTO OPERATION & REVERT TO MANUAL OPERATION

Select Fix -

Press GB Check button -

Observe 000.0 in Distimeter.

Chart waypoints may now be inserted in the usual manner.

SETTING UP IN POOR OR NO RECEPTION

1. At F. Log Controller select 'Harco' and 'Fix' -
2. Select chart for a position (preferably a beacon) to which A/C must fly where reception is known to be adequate, ensuring that a long digit track is read in. If chart already in view, run off and back again through long digit track -
3. Position cursor -
4. Select 'Search' without pause en route -
5. As A/C overflies position, pull Function Switch and rotate quickly to 'Fix', release switch and then select 'Op'.

DEFINING GHOST BEACON ON CHART

To reduce chart movement, delay until required.

1. Select 'Search' -
2. Move chart/cursor to position required -
3. Select 'Op'. The Ghost Beacon is now stored.

GHOST BEACON POSITION CHECK

1. Select 'Check' -
2. Check GS key not beneath arrow -
3. Press 'GB Check' button, cursor indicates position.

GHOST BEACON OPERATION

1. At Distimeter select GB and NM or Min -
2. At Turret check GS key not beneath arrow.
3. See RBI and Distimeter ('Op' selected).

SETTING UP FOR MANUAL OPERATION

1. Check Omnitrac/FCS Controller 'Off'
2. Fit Chart (detailed below) -
3. At F. Log Controller set 'Harco' & 'Fix', see amber w/lt on steady and red w/lt flashing then without delay -
4. Select required chart and see amber w/lt long flashing. If required chart is already in view, run completely off and back again through long digit track -
5. Set cursor on A/C approx position within relevant zone box -
6. Select 'Op', check that within 90 secs, Zone Ident Meter pointer moving, amber w/lt short flashing and red light out.
7. Press Update button to clear amber light. If flashing persistent or if incorrect position displayed, select 'Harco Int'.
8. Select 'Chart WP' -
9. Set cursor on waypoint (1) -
10. Press WP1 button until lamp flashes -

/Cont'd. ...

11. Repeat for WP2 and WP3 -

12. Select Check -

13. Press WP1, see cursor goes to WP1 and light steady.

14. Repeat for WP2 and WP3.

15. Select Op, see cursor returns to aircraft position and red light out.

FLIGHT OFF CHART SIDE

1. Select 'Search' until back on chart then -

2. Select 'Op'.

TO SEE CHART AHEAD OR ASTERN

1. Select 'Chart WP' -

2. Press appropriate chart control button -

3. Select 'Op' to resume current chart.

CHART FITTING

1. Switch Off at F. Log Controller

2. See digit track on right of chart is next to green flange of spool, and end of chart with roll name and issue number is facing outwards from spool -

3. Loosen screws at top corners of Display Head and pull down front -

4. Pull out lower half of assembly and lift until the strut on the right can be pushed to latch

5. Rotate lever at right of housing anti-clock -

6. Insert spool with green flange to right -

/Cont'd. ...

7. Rotate lever clockwise to engage spool. If catch becomes stiff, rotate spool slightly.

8. Draw out about 2 feet of chart -

9. Pull strut forward, lower assembly and push home -

10. Lower top half of assembly and clip chart to upper spool -

11. Push upper assembly into position -

12. Select 'Fix' ensuring that upper and lower assemblies remain pushed home.

13. Replace face of display and do up screws.

CHART REMOVAL

1. Wind chart on to lower spool by pressing top button until the appearance of some arrows and the words 'Press South Button' -

2. Switch Off at F. Log Controller -

3. Loosen screws at top corners of Display Head and pull down front -

4. Lower top half of assembly and unhook chart -

5. Pull strut on the right of the lower assembly forward, lift until the strut can be pushed to latch -

6. Rotate lever at right of lower housing anti-clock -

7. Withdraw lower spool and chart -

8. Rotate lever at right of lower housing clockwise -

9. Replace assemblies -

10. Replace front and screw up fastening.

ADF SYSTEMS

GENERAL. Two AD360 installations from independent, identical twin systems each providing:-

Reception of CW (A0 or A1); MCW (A2); R/T (A3) -

Continuous automatic direction finding -

Aural manual direction finding without sensing.

Frequency coverage is 100 to 450 Kc/s and
460 to 1799.5 Kc/s in 0.5 Kc/s steps.

The main units are:-

2 Controllers - 2 Loop aerials

2 Receivers - 2 Sense aerials

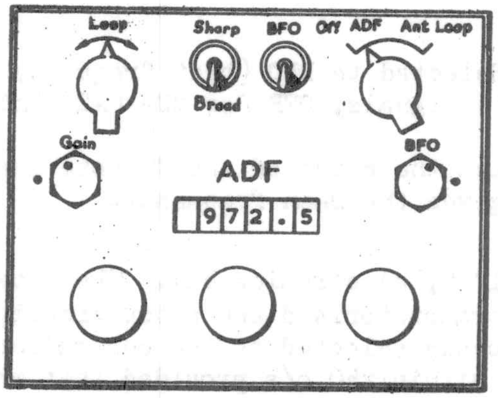


FIG.1 ADF CONTROLLER

CONTROLLER. Two, mounted on the pedestal. This carries all the controls for the system, is integrally illuminated and incorporates:-

Tuning switches. The three larger rotary switches select, from the left, hundreds, tens and 0.5 units of Kc/s, seen in the aperture. The entire range from 100 to 1799.5 Kc/s may be selected, including the unusable 10 Kc/s from 450-460 Kc/s.

/Cont'd. ...

Function Switch. Marked Off-ADF-Ant-Loop.

Off.	All power off.
ADF.	Automatic direction finding.
Ant.	Operating as normal receiver, using sense aerial.
Loop.	Operating as normal receiver using loop aerial, plus manual aural direction finding.

Loop Control Switch. Operated in conjunction with the Loop and ADF positions of the Function Switch, this actually controls the rotation of the goniometer search coil. Spring loaded to off in the centre, the direction and speed of rotation of the search coil varies with the direction and amount of Loop switch movement.

Sharp/Broad Switch. Varies receiver selectivity. Band passed on Sharp 1.2 Kc/s, Broad 3 Kc/s.

Gain Control. Self evident. Alignment of the white dots gives minimum volume.

BFO/Off Switch. Selected to BFO (beat frequency oscillator) to read CW (A0 or A1) signals, OFF for MCW (A2) and R/T (A3).

BFO Control. Varies the pitch of the CW note heard. Alignment of the white dots gives the mean frequency.

RECEIVER. Two, on shelf 5, electronics bay. The receiver is crystal controlled, completely transistorised and automatically tunes, in two seconds, to the frequency selected at the controller. The frequency is accurate to within ±50 c/s provided that whenever the power is interrupted, the frequency in use is re-selected. Frequencies outside the stated coverage must not be used for ADF.

LOOP AERIAL. Two, on upper fuselage centre line, ADF1 foremost. This is non-rotating and formed of two flattened loops fixed at right angles to each other and mounted, on the longitudinal axis, with their planes vertical to the horizontal plane of the aircraft.

A fixed quadrantal error correction of $+14\frac{1}{2}^{\circ}$ is built in by using more turns in the fore and aft loop than the athwartships one. Additional QE correction is provided by a QE and loop equaliser unit.

SENSE AERIAL. Two, mounted in the wing root fairings, ADF1 port. This is a suppressed type, and is employed as a simple aerial when Ant is selected at the Function Switch. In ADF it is used in resolving the 180° ambiguity of the loop to provide bearing sense. A sense equaliser unit adjacent to the receiver matches the aerial to the receiver.

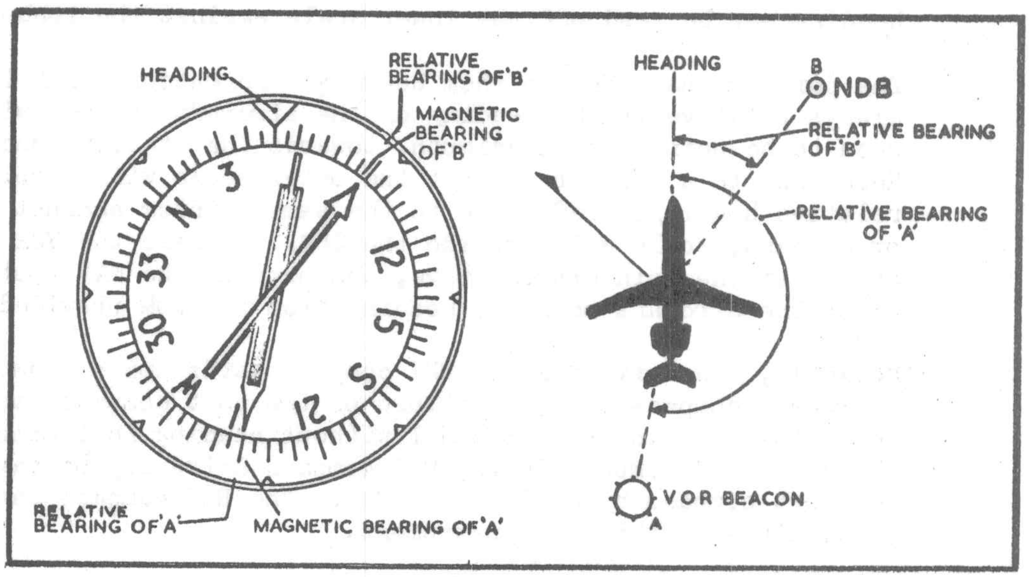


FIG.2 RMI BEARING PRESENTATION

BEARING PRESENTATION. Relative bearings from each ADF system are presented on two Radio Magnetic Indicators on which they may be seen as relative or magnetic.

The RMI may show, simultaneously, the aircraft heading and relative and magnetic bearings from:-

Both NAV systems (VOR) or -

Both ADF systems or -

Either one of the ADF and NAV systems.

Cont'd. ...

The instrument (Fig.2) carries two concentric 360° scales, a compass lubber mark and two pointers. The outer, fixed scale, against which relative bearings are read, is simply calibration pips at 45° intervals. The inner, rotating scale with a perimeter of 5° calibrations, is a compass repeater.

Residual deviation affecting the FCS compass is small enough to be disregarded for this purpose, so we may say that magnetic heading may be read off the inner scale against the lubber mark.

The pointers have fed to them bearing information which is always relative to the heading of the aircraft so they will be seen to be pointing, in azimuth, towards the station concerned. Reference to a pointer against the outer scale will thus show a relative bearing; reference to the same pointer against the inner, or compass, scale will provide the QDM. To make the VOR presentation at the pointers relative, synchros in the NAV system subtract the aircraft magnetic heading from the QDM provided by VOR.

Normally, the drive for the RMI compass cards comes from the starboard compass so that failure of the port compass does not leave the port instrument panel without heading indication. If the starboard compass fails, RMI compass drive may be taken from the port compass by a plug transfer. The RMI compass card drive is amplified within the instrument.

One of the RMI pointers is red, single barrelled and presents the bearing information from ADF1 or NAV.1. The other pointer is green, double-barrelled and presents the bearing information from ADF2 or NAV2 systems. Two switches control the inputs to the pointers.

RMI INPUT SWITCHES. Two ADF/VOR switches on the pedestal control the input to the RMI pointers. The left hand switch feeds ADF1 or VOR1 bearings to the red pointers of both RMI's, the other feeds ADF2 or VOR2 bearings to the green pointers of both RMI's. The switches also feature in input indicator circuits.

RMI INPUT INDICATORS. Two magnetic indicators adjacent to each RMI show:-

ADF1 or VOR1 input to the red pointers of both RMI's.
ADF2 or VOR2 input to the green pointers of both RMI's.

The circuit to the ADF side of these is complete when:-

ADF is selected at the RMI Input switches.
The associated ADF system Function Switch is at ADF.

The circuit to the VOR side is complete when:-

VOR is selected at the RMI Input switches -
The NAV controller is ON and a VOR frequency is selected.

POWER SUPPLIES. These are featured in Power Supplies & Cooling. It will be seen that ADF1 is fed from the Radio Essential DC Bus and remains available until the aircraft battery is exhausted.

WEATHER RADAR SYSTEM

GENERAL. The EKCO 290 Weather Radar system provides continuous indication of cloud range and bearing, indicates most turbulent cloud, and may be used to determine cloud height or to 'paint' a map of the surface ahead of the aircraft.

Pulses of RF energy are radiated in a 3.7° pencil beam, or in an edgewise 75° fan-shaped beam, sweeping 90° either side of the aircraft head. Some of this energy is reflected back and presented as information on a cathode ray tube screen. The scanner is stabilised in pitch and roll.

Reflections from denser clouds, such as Cu Nb supporting large water droplets, give the brightest return. The range from which returns would be expected may be reduced in direct proportion to the density of intervening rain. Due to the penetration of clouds by some of the energy, returns may be seen from the full horizontal extent of a layer up to the maximum range of the system.

It should be noted that a cloud-enveloped mountain-top may give the same indication as a fully developed Cu Nb cloud. The hail content of a Cu Nb may appear as a pointed or a hooked finger, and the edge of the cloud scalloped. A rapidly changing cloud shape indicates a probability of turbulence and the possibility of hail

INDICATOR UNITS (2). At forward ends of port and starboard consoles. Each incorporates a display screen and all the system controls as shown in Fig.1. The screen has engraved bearing markers at 15° intervals.

Range markers are electronically produced in accordance with the range selected and are linear in scale.

Power Switch.

'POWER OFF' position	All power is off.
'POWER ON' position.	Power and stabiliser are operative within two minutes of switching 'On'.
'STAB OFF' position.	The gyroscope stabilisation is off, so the scanning plane will vary with the aircraft attitude.

Range Switch.

'STANDBY' position. Provided the power switch is On, the equipment is held in readiness at operating temperature, scanning becoming operative immediately a 'range' position is selected. The range positions of 20, 50, 150 nautical miles are self evident.

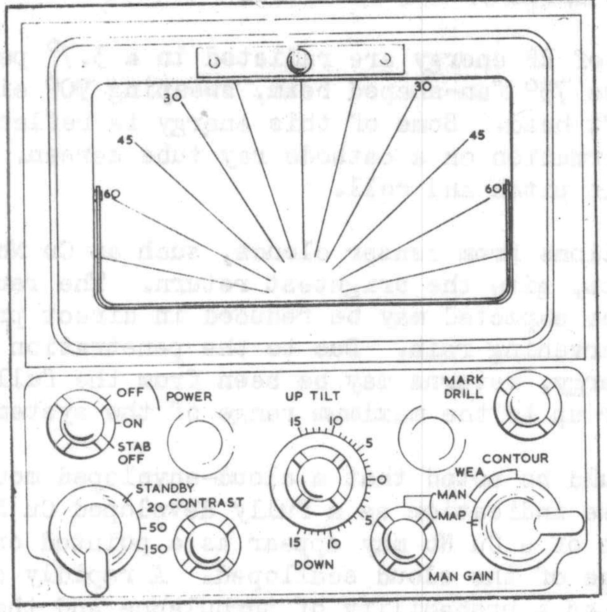


FIG.1 INDICATOR UNIT

Contrast Control. Adjusts display to suit flight deck lighting conditions.

Tilt Control. Allows up to 15° elevation or depression of beam.

Man Gain Control. Manual receiver gain control in Man and Map positions of the Function Switch.

Function Switch.

CONTOUR. Returns above a pre-set level are inverted so that they produce less brilliance on the screen instead of more, regardless of range. Thus the active centres of Cu Nb cloud appear as dark areas. STC (Sensitivity Time Control) circuits also operating.

WEA. STC operating. Manual receiver gain is inoperative and display intensity remains constant for a given target up to a range of 24 n.m. Beyond this, intensity decreases with increase in range.

Cont'd. ...

MAN. Manual receiver gain control operative, STC inoperative.

MAP. The beam is modified, so as to sweep on area in front of the aircraft. The swept area is presented on the screen as a map revealing significant physical features. The size of the area displayed will depend on aircraft height, range in use and scanner tilt. Manual gain is operative.

Marker Brilliance Control

Varies brilliance of range markers.

Master Indicator Lamps (2). One above the screen of each controller. A small neon lamp which lights when the appropriate Radar Control switch is pressed.

RADAR CONTROL switches (2). One below each indicator. When a switch is pressed its indicator takes over control of function and aerial tilt, and the master indicator lamp lights. If the 'master' indicator is switched off, control reverts automatically to the other indicator, if it is switched on.

TRANSMITTER/RECEIVER. Panel RC, electrical bay. This unit incorporates circuits which produce the various power supplies from the aircraft 115V AC and 28V DC, form the synchronising pulses and generate the radiated energy. It also contains receiver local oscillator and mixer stages and one IF amplifier stage.

The front of the unit carries two fuses, one in the power supplies transformer primary the other in the main supply line to the transistors.

SCANNER. Nose radome. This unit incorporates components for forming, propagating and receiving the beam, for scanning ahead, for stabilising the aerial in pitch and roll and for synchronising the Indicator display. The rotating parts are the 24 inch parabolic reflector and dipole aerial.

POWER SUPPLIES. These are shown in Power Supplies & Cooling, Figs. 1 & 2. Due to the time taken by the Radio AC Supply Relays to change over, the system will go off for 2 minutes from the time 1 Main AC Bus is de-energised or re-energised.

ATC TRANSPONDER

GENERAL. The Cossor SSR2100 ATC Transponder system automatically responds to interrogation from the ground to provide aircraft control authorities with aircraft identification, flight level and tracking information. It may also be used to acknowledge ATC messages in the event of failure of aircraft R/T transmitters and to indicate that an aircraft is in distress. Range of the system with standard ground equipment is 180-200 n.m at 40,000 ft. Two Transponder Units and one Controller are carried.

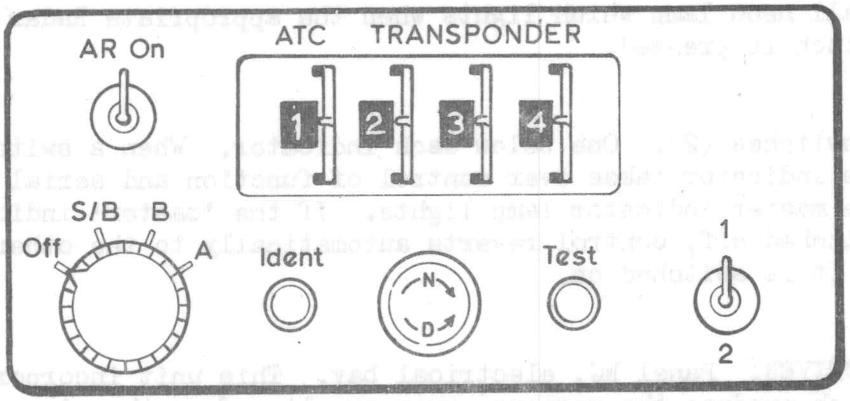


FIG.1 TRANSPONDER CONTROLLER

CONTROLLER. On the pedestal, this carries controls as follows:-

Function Switch. Marked Off - S/B - A-B.

Off	-	All power off.
S/B	-	Power on. After one minute, both systems ready but not responding.
A,B	-	Mode selections. System will respond accordingly on interrogation, A & B both for identification, tracking and flight level.

Code Digits Selector Switches. Four edge-operated switches select the code digits.

Ident button. Pressed and released, this initiates an identity pulse response on modes A & B, lasting for not less than 20 seconds.

Test button. This is pressed to operate the self-test circuits. Visual indication of serviceability is given on the Monitor Lamp, which should remain lit for 10-15 seconds.

Monitor Lamp. In addition to the test response, this lamp lights when the aircraft is responding with adequate power. It may also come on for 15-20 secs when S/B is selected from Off. This is not abnormal.

AR switch. With this switch On, flight level response is given in Mode C provided A or B mode is selected.

1-2 Switch. System selector. The unselected system remains in stand-by mode ready for instant response on selection.

TRANSPONDER UNIT (2). Mounted on shelf 7, electronics bay. This contains power supply, receiver, decoder, amplitude comparison, encoding and transmitting circuits. The receiver frequency is 1030 Mc/s and the transmitter 1090 Mc/s.

AERIALS (2). Lower fuselage centre line, labelled 'Transponder', No 1 fwd.

POWER SUPPLIES. 28V DC as shown in Power Supplies & Cooling.

MANAGEMENT

PRE-FLIGHT

1. Function switch - S/B.
2. AR switch - ON.
3. Code 00 00.
4. After one minute from switch-on, select mode A and press Test button.
   If system serviceable, monitor lamp lights for 10-15 secs.
5. Test other system.

/Cont'd. ...

6. Function switch - S/B.

7. Code letter I in item 10 of Flight Plan indicates serviceable SSR (Secondary Surveillance Radar) type Transponder. N indicates unserviceable Transponder.

IN FLIGHT

1. Function switch to remain at S/B until requested to select code and mode.

2. On leaving one ATC for another, continue with the same mode/ code unless requested to do otherwise.

3. The Ident button should be pressed only at ATC request to 'Squawk Ident'.

4. If coms reception failure complete, select code 76 00 and mode A and follow established procedures.

5. If 'Mayday' transmitted, continue with any allocated mode/ code. If none allocated or no response to 'Mayday' call, select code 77 00 and mode A.

FLIGHT RECORDER

GENERAL. The Plessey-Daval flight recorder system records, in the form of binary coded digits on two separate recording decks the following detail against time:-

Flight level
Airspeed
Heading C
Pitch attitude
Roll attitude
Radio height

A/Pilot engagement
A/Throttle "
Height Acq "
Height lock "
Speed lock "
Glide grg selection
Prime land selection

Engine power
Flap angle
Stick shake
Stick push
Vertical acceleration

Flight level, vertical acceleration, airspeed and engine power are derived from the system's own transducers, heading is taken from the port compass system, pitch and roll from vertical gyro 3. The remaining parameters are taken from the relevant sub-systems.

CONTROLLER (Fig.1). Mounted on the port console, the Controller carries all the controls for normal operation -

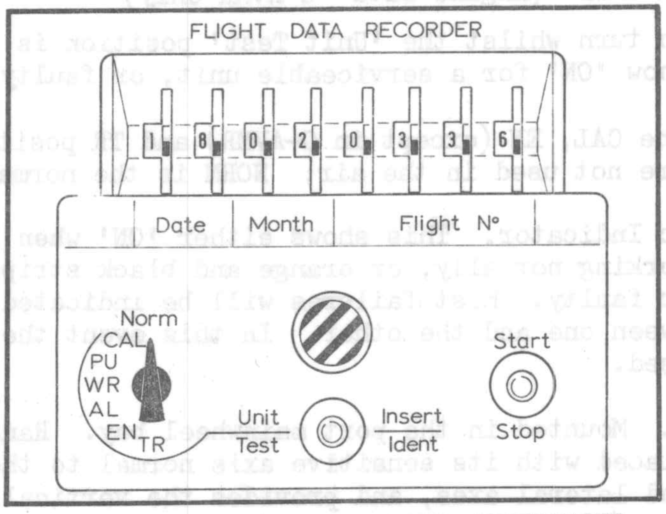


FIG.1 FLIGHT RECORDER CONTROLLER

Start-Stop Switch. Spring loaded to centre, function self-evident, but operative only on the ground. The switch is ineffective once the weight is off the undercarriage when an oleo switch starts the Recorder automatically if 'Start' has not already been selected. The oleo switch stops the Recorder about 64 seconds after touch-down.

Date/Flight No. switches. Eight edge-operated rotary switches allow the date, month number and all four figures of the flight number to be set in the eight apertures. Zero is set to precede 3-figure flight numbers, 9999 for flights with no flight number. The first three switches may also be used to set the first three figures of the take-off weight in kg.

Unit Test

Insert Ident switch. Sprung to centre off. When operated to 'Insert Ident' and released, the recorder is switched on temporarily and the flight identification or take-off weight as set above, will be recorded at least eight times in place of any other information. The magnetic indicator will show 'ON' for 64 seconds if there is no fault. To prevent loss of data when airborne, the oleo switch inhibits the 'Insert Ident' switch function with weight off.

The 'Unit Test' position is used, in conjunction with the adjacent rotary switch, to check individual units when a fault is indicated by an oscillating MI. The rotary switch is set to

PU (Processing Unit)
WR (Wire Recorder)
AL (Autoland) inoperative
EN (Engine Data - G-AVMR only)

in turn whilst the 'Unit Test' position is held. The MI will then show 'ON' for a serviceable unit, or faulty otherwise.

The CAL, EN (except in G-AVMR) and TR positions of the rotary switch are not used in the air; NORM is the normal operating position.

Magnetic Indicator. This shows either 'ON' when the system is on and working normally, or orange and black stripes, as in Fig.1 when off or faulty. Most failures will be indicated by it oscillating between one and the other. In this event the test switch should be used.

ACCELEROMETER. Mounted in the port mainwheel bay. Range -5g to +5g, this is placed with its sensitive axis normal to the aircraft fore and aft and lateral axes, and provides the vertical acceleration output.

PROCESSING UNIT. Mounted on shelf 5 of the radio rack. This unit contains the flight level and airspeed transducers, the timing circuits, and the circuitry concerned with converting the various information signals into a form suitable for recording, and assembling them in the correct order. It also holds the system self-checking circuits.

RECORDING DECK. Mounted on the starboard shear deck behind the ventral stairway furnishing panel, this has two parts, the Drive Unit and the Casette.

The Drive Unit holds cassette drive motors, a power pack, an amplifier and a device for controlling recording wire tension.

The Cassette holds approximately 50 miles of 0.002 in. diameter stainless steel recording wire, sufficient for 300 hours recording, wire carriage and tensioning devices and erase, record and monitoring heads. It is designed to ensure that the record has a very good chance of surviving the worst crash.

QUICK ACCESS TAPE RECORDER. Mounted in the flight deck radio rack and operating in parallel with the Flight Recorder, this unit records the same detail. It has seven hours recording capacity.

Inserting the tape cassette resets the deck to track 1. If the cassette has already been used, any new recording would erase that already on the tape.

POWER SUPPLY. Single phase 115V 400c/s for both Recorders from Radio 1 AC Bus as shown in Power Supplies & Cooling.

FLIGHT INSTRUMENTS

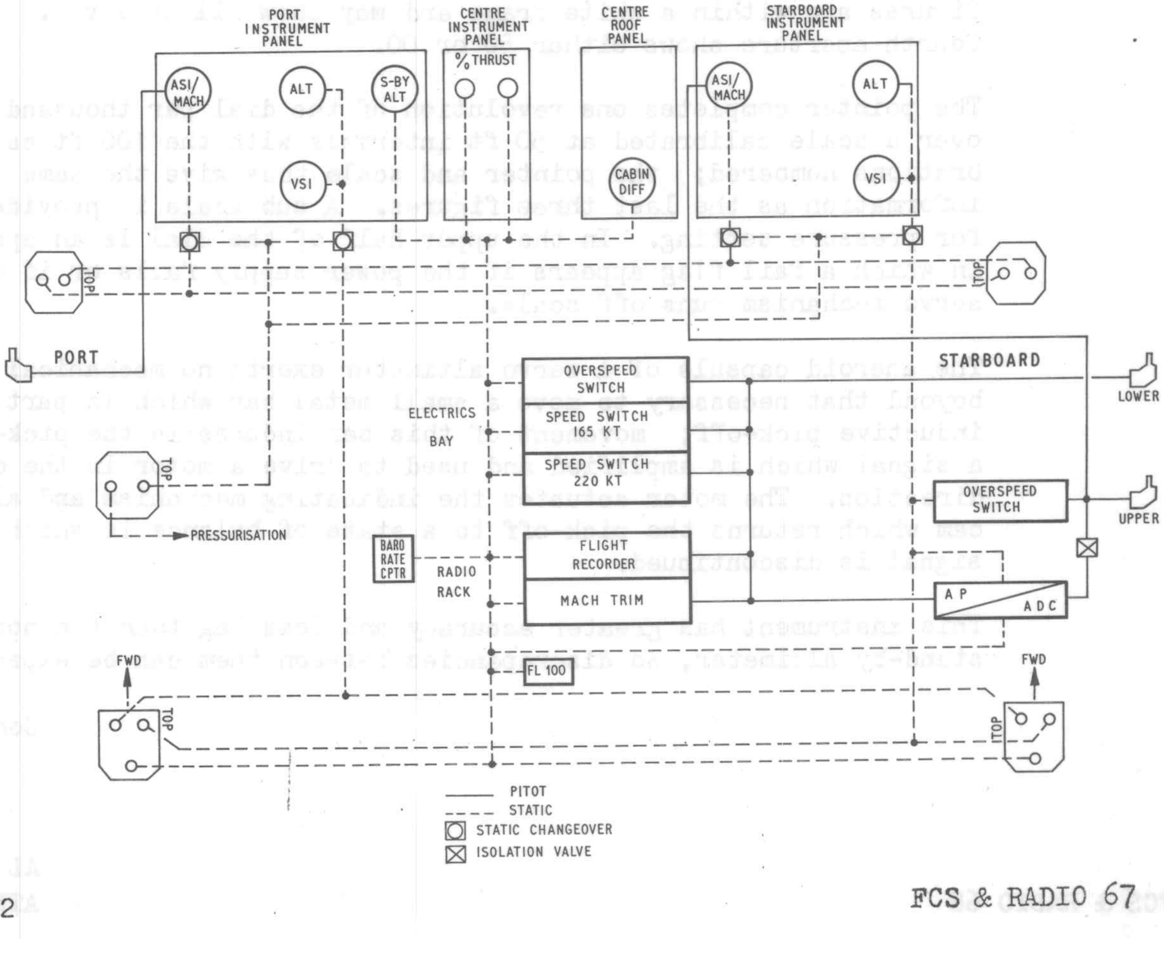
PITOT/STATIC SYSTEM

General

Pitot pressure for the ASI's, etc, is taken from one pitot pressure head on the port side of the forward fuselage and two on the starboard side; the air data sensor can be isolated from the system. Static pressure is taken from five vent plates on the forward fuselage, and it is possible to connect the flight instruments to alternative sources of supply.

STATIC changeover valves (4). Two on bottom edge of port instrument panel, two on starboard panel. Marked 'ASI' and 'Air Data', with 'Normal' and 'Alternative' positions, and held in the 'Normal' position by spring guards. The 'Air Data' valve controls the supply to the altimeter and VSI.

AP PITOT ISOLATING SWITCH. Under Free Fall Lever cover at foot of starboard console. When set to 'Isolate' cuts off the pitot pressure supply to the air data computer.



ASI/MACHMETERS (2). Port and starboard instrument panels. Outer scale 60-200 kt, then Mach number; inner scale 200-400 kt, over same arc as Mach number. The setting of the Mach number scale is adjusted by an altitude capsule in conjunction with the airspeed capsule. The single pointer is waisted near its tip to permit the reading of both the higher airspeeds and the Mach number. A triangular yellow index mark at the edge of the dial may be set to any required position by means of a knob at the bottom of the instrument.

TURN & SLIP (2). Port and starboard instrument panels. Rate of turn is indicated by a gyro-actuated pointer, and slip and skid are indicated by a ball-in-tube inclinometer. An OFF flag appears in a cut-out in the dial whenever the gyro rotor speed falls below the correct value. The single-phase 115V ac power supply is cut off whenever both HP fuel levers are at 'Shut' and the weight is on the undercarriage.

ALTIMETERS (3). The port and starboard altimeters, on their respective instrument panels, are of the -1000 to +50,000 ft range servo-driven type. The presentation is by means of figures in four apertures in the dial, and one pointer. From left to right the figures show increments of ten thousand, one thousand and one hundred feet; these figures are within a white frame and may show flight level. The fourth aperture shows either 50 or 00.

The pointer completes one revolution of the dial per thousand feet, over a scale calibrated at 50 ft intervals with the 100 ft calibrations numbered; the pointer and scale thus give the same information as the last three figures. A sub scale is provided for pressure setting. In the upper half of the dial is an aperture in which a fail flag appears if the power supply fails or if the servo mechanism runs off scale.

The aneroid capsule of a servo altimeter exerts no mechanical effort beyond that necessary to move a small metal bar which is part of an inductive pick-off; movement of this bar induces in the pick-off a signal which is amplified and used to drive a motor in the correct direction. The motor actuates the indicating mechanism and also a cam which returns the pick-off to a state of balance in which the signal is discontinued.

This instrument has greater accuracy and less lag than the non-servo stand-by altimeter, so discrepancies between them can be expected.

Cont'd. ...

Some tolerance figures for the two types of altimeter are:-

Altitude Ft x 1000	Altimeter Tolerances Ft ± SERVO	STAND-BY
-1) 0) 1)	30	70
2	30	80
3	30	90
4	35	90
10	35	150
15		250
20	50	350
25		450
30	75	500
QFE setting tolerance	±30	±50

The maximum indicated differences can be obtained by adding the maximum calibration error tolerances. Power supply 115V AC.

Flight level signals for the Transponder and Omnitrac are taken respectively from the port and starboard instruments.

The standby altimeter, on the port instrument panel, is capsule-operated with a range of -1000 to 50,000 ft, and is connected to both of the three-vent static vent plates. It has conventional two pointer and concentric arc presentation, and a pressure sub-scale.

SERVO ALTIMETER test switches (2). Outboard of port and starboard instrument panels. Three positions, spring-loaded to centre ('Normal'). These switches are for maintenance purposes only, and must not be used in flight.

FL100 warning lamps (2). Green, adjacent to port and starboard altimeters, in press-to-test, press-to-cancel holders. An altitude sensing unit causes the lamps to flash when the aircraft descends through FL100 ± 500 ft, until cancelled by pressing and releasing either lamp. When the 28V DC supply to the system is initiated on the ground, the lamps will flash until cancelled, and a momentary interruption of the power supply at any time will also cause the lamps to flash until cancelled.

/Cont'd. ...

The system may be tested by pressing either lamp below FL100, when both will flash until the pressure is released. The test facility is not available above FL100 ± 500 ft.

VSI's (2). Port and starboard instrument panels. The conventional type of instrument in which the lag in pressure equalisation in a very sensitive capsule is used to indicate the rate of change of altitude up to 6000 ft/min.

CLOCKS (3). An eight-day time of flight clock with a sweep seconds hand is mounted outboard of the starboard instrument panel. The glass, mounted in an adjustable bezel, carries a lubber mark; the knob winds the clock and is pulled out to set the hands.

Elapsed time clocks are mounted on the port and starboard instrument panels. The shorter hand, moving over the inner scale, shows minutes up to 12, and the longer hand shows seconds up to 60 on the outer scale. The push-button at the bottom of the dial resets the hands to zero, and the knurled knob is used to wind, start, and stop the clock.

TOTAL AIR TEMP gauge. Centre instrument panel, range -60 to +60°C, indicates outside air temperature. The temperature bulb is mounted on the port side of the nose. Power supply 28V DC.

A/C G-AVMR only:-
An additional temperature probe is fitted high on the starboard side of the aircraft nose. This is for obtaining OAT data for the Engine Data Acquisition Unit, and is not concerned with Flight Deck instrumentation.

STAND-BY ARTIFICIAL HORIZON. On the port instrument panel. A warning flag appears at the top of the dial if the power supply fails, if the instrument fails, or when the Fast Erection button is pressed. The Fast Erection button provides rapid erection of the gyro. It must not be pressed within 30 seconds of switching power on or for more than 60 seconds at a time. A false attitude will be indicated if it is pressed during acceleration, deceleration or during a turn. The single phase 115V AC power supply is cut off whenever both HP fuel levers are at 'Shut' and the weight is on the undercarriage.

STAND-BY COMPASS. Type E2B, mounted at the top of the centre windscreen pillar. It is internally lit, the switch being on the starboard roof panel.

POWER SUPPLIES & COOLING

GENERAL. The FCS and all radio systems power supplies are automatically fed, via the cb's on Panel B, from the aircraft bus bars to the Radio and Electronic Bus Bars, of which there are three DC and two AC. There are no master switches controlling the supplies to these. Supplies to the individual systems or units, are taken from the R & E Bus Bars via the cb's on Panels RA and RB.

AC SUPPLIES. Fig. 1 shows the AC supply circuits; the 115V and 26V distribution lists are shown separately.

The Radio and Electronic AC Bus Bars 1 & 2 are normally fed from 1 Main AC Bus Bar through two normally energised R & E AC Bus Relays. The coils of these relays are energised, from 1 Main AC Bus, only when its voltage and frequency are within certain limits, and the SSB is open. When the R & E AC Bus Relays are relaxed, supplies for the R & E AC Bus Bars are taken from 2 Main AC Bus Bar.

The Undervoltage and Frequency Sensing units contacts (see Fig.1) open just before 1 GCB on generator failure so that the supply change - over is effected before 1 Main AC Bus actually fails. The R & E AC Bus Relay coils are energised through the relaxed SSB to reduce the number of times the relays operate, although, in the case of 2 Main AC Bus failure, an unnecessary relay operation results.

POWER FAILURE WARNING LAMP. Amber, ptt, at top of Panel RB.

Provided the Essential R & E DC Bus is energised, the lamp comes on whenever either or both of the R & E AC Bus Relays are relaxed. It will, therefore, be on when an AC ground supply is connected or when only one Generator (1 or 2) is on line; that is, whenever the SSB is closed. It does not, then, necessarily indicate power failure.

If the lamp comes on when both Generators 1 & 2, or the APU Generator is on line, it indicates that either or both R & E AC Bus Relay coils have failed or the 'Undervoltage Unit' cb489 or the 'Radio Power No.1' cb 13 is tripped. If either cb trips or both relay coils fail, both R & E AC Bus Bars will be switched to 2 Main AC Bus. If one relay coil fails, only the associated R & E AC Bus will be so switched.

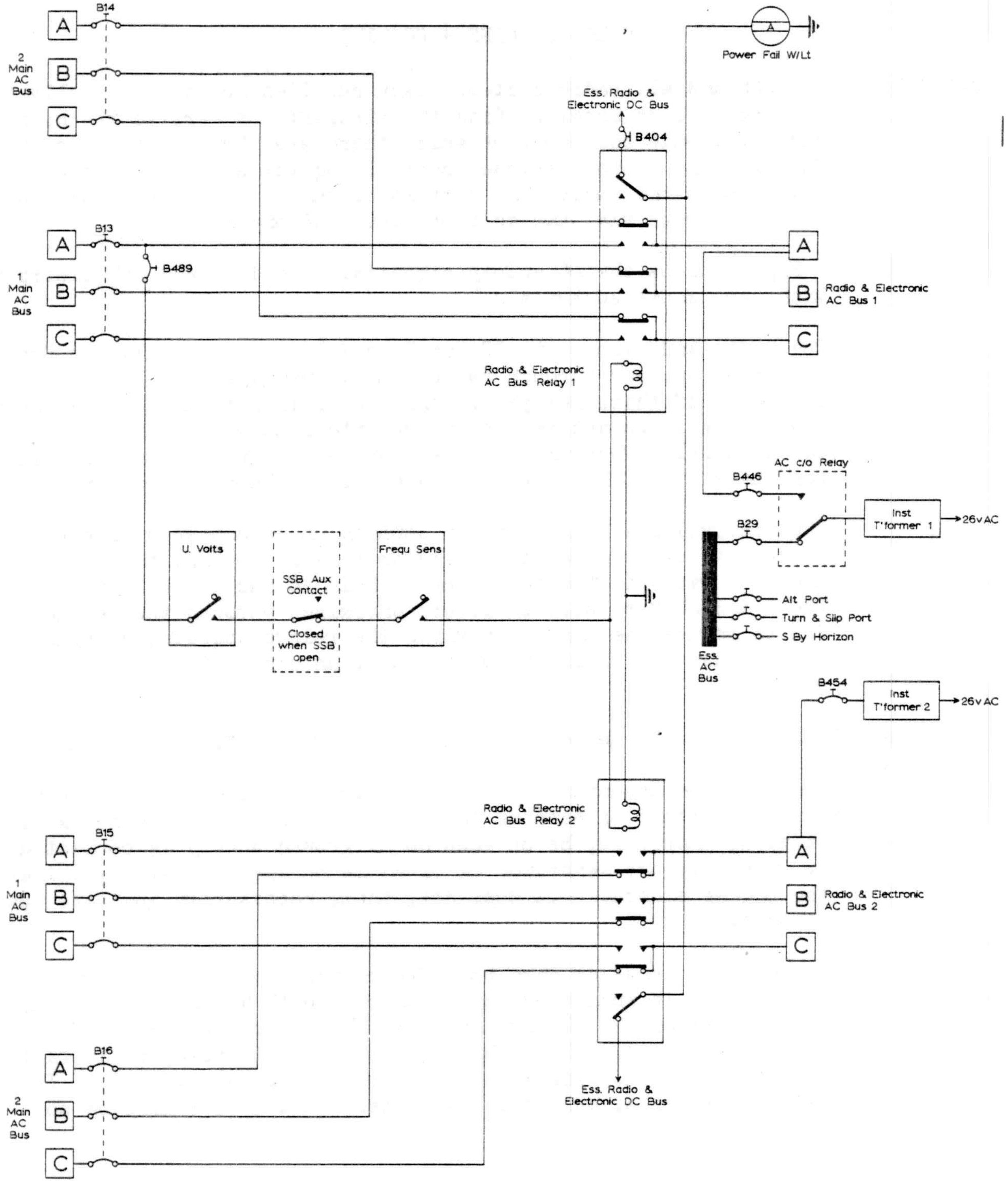


FIG. 1 AC SUPPLIES

RADIO & ELECTRONIC AC BUS BAR DISTRIBUTION

R & E Bus 1

Phase A

Inst Transformer 1 — 26V →
Autopilot
Port Att Amp
1 Vertical Gyro
Port Compass Display
Port Compass Amp
Port Master Comp Unit
1 Directional Gyro
ADC
Autothrottle
Flt Recorders
1 Radio Sw Unit 'A'

26V (Inst Transformer 1):
Compasses
ADF 1
NAV 1
RMI cards &
red pointers

26V (Inst Transformer 2):
Omnitrac
Compasses
ADF 2
NAV 2
RMI green pointers
FCS Mode Sw
Flt Recorders

Phase B

Autopilot
Port Att Amp
Port Compass Display
Port Compass Amp
Port Master Compass Unit
Radio Cooling Fan 1
1 Radio Sw Unit 'A'

Phase C

Autopilot
Port Att Amp
Port Compass Amp
Port Master Comp Unit
Compass Comparator
IF Monitor
Radio Altimeter
1 DME
GPWS & Baro Rate Computers.

R & E Bus 2

Att Comparator
Stbd Att Amp
2 & 3 Vertical Gyro
Stbd F Dir Amp
Port F Dir Amp
Interface Modulator
Stbd Compass Display
Stbd Compass Amp
Stbd Master Comp Unit
2 Directional Gyro
Steering Computer
Overshoot Computer
Radio Devn Comparator
Weather Radar
2 Radio Sw Unit 'A'
Radio Sw Unit 'C'
Inst Transformer 2 — 26V →

Stbd Att Amp
Stbd F Dir Amp
Port F Dir Amp
Interface Modulator
Att Comparator
Stbd Compass Display
Stbd Compass Amp
Stbd Master Comp Unit
Radio Cooling Fan 2
Weather Radar
Radio Devn Comparator
2 Radio Sw Unit 'A'
Radio Sw Unit 'C'

Stbd Att Amp
Stbd F Dir Amp
Port F Dir Amp
Interface Modulator
Att Comparator
Stbd Compass Amp
Stbd Master Comp Unit
Mach Trim
2 DME
Weather Radar
Radio Devn Comparator

DC SUPPLIES. Fig.2 shows the 28V DC supply circuits and distribution.

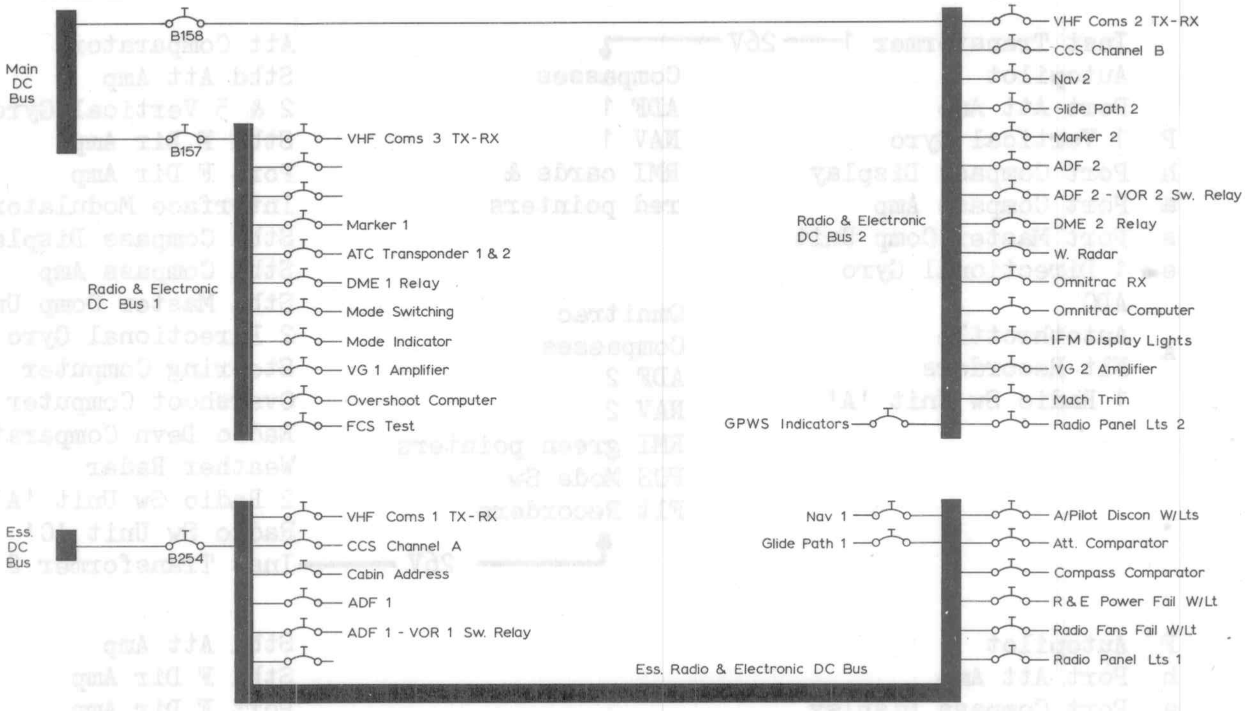


FIG.2 DC DISTRIBUTION

RADIO COOLING FANS switch. Mounted on the roof panel and marked No.1 - No.2, this switch controls the supply to the fan motors. The switch has no off position so the selected fan will run whenever the Main AC Bus Bars are energised.

The fans draw cooling air through the electronics racks in the electronics bay and flight deck.

FANS FAIL warning lamp. Amber, ptt, on the roof panel. Provided the Essential R & E DC Bus is energised, the lamp comes on if neither radio cooling fan is running. The lamp is connected to the amber MWS.

COMMUNICATIONS

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COMMUNICATIONS CONTROL SYSTEM

GENERAL. The Elliott EA75A Communications Control System (CCS) provides:-

Selection of receiver audio output -
Selection of communication transmitters -
Use of Cabin Address system -
Intercom between: Flight deck stations -
Flight deck and pantries -
Flight deck and ground -
Pantries.

Reliability is improved by segregation of flight deck and cabin/ground staff intercom circuits so that the latter cannot interfere with the former. It is further improved by duplication of flight deck circuits. Failure of one of these duplex channels would probably not be noticed as the system would automatically continue in simplex. Provision is made for separate testing of the duplex channels A & B. Units comprising the system are:-

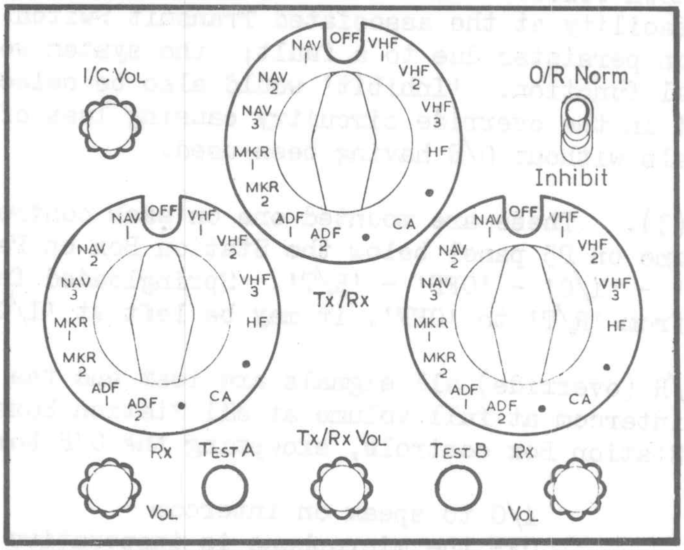

FIG 1 STATION BOX

STATION BOX (3). See Fig 1. These are mounted on the port and starboard consoles and panel R, and carry the following controls:-

Selector Switches. Three rotary switches each marked as shown in Fig 1 allow selection of those systems, thus giving simultaneous reception of three outputs. Additionally the centre, Tx/Rx, switch allows transmission on VHF1, 2 and Cabin Address, with provision also for VHF3 and HF.

Vol Controls. Continuously variable, one below each selector switch controlling Station Box output level of receiver selected.

I/C Vol Control. Continuously variable, controlling intercom reception and side-tone volume.

Test A
Test B push buttons. These allow the disablement of each channel in turn so as to check that the other is serviceable. Pressing 'Test A' disables channel B and vice versa. On pressing a Test button, reception normally fades at first and then, within seconds, returns to normal if the channel is serviceable.

O/R Norm-Inhibit switch. In the normal operating position, 'O/R Norm', the O/R selection at the associated Transmit Switch will operate as shown below. 'Inhibit' would be selected if, after using the O/R facility at the associated Transmit Switch, the override condition persisted due to a fault; the system would then revert to normal function. 'Inhibit' would also be selected to counter a fault in the override circuitry causing loss of selected receiver signals without O/R having been used.

TRANSMIT SWITCH (3). These are mounted one on each control column handgrip and one on P3 panel below the Station Box on Panel R, and are marked 'O/R' - 'I/C' - 'OFF' - 'R/T'. Springloaded from 'O/R' to 'I/C' and from 'R/T' to 'OFF', it may be left at 'I/C'.

At O/R (override) all signals are lost and the user is heard on the intercom at full volume at all Station Boxes regardless of the Station Box controls, excepting the O/R Norm - Inhibit switch.

I/C to speak on intercom -
OFF the microphone is inoperative -
R/T to use the transmitters or Cabin Address.

The switch operates in the same manner for either the headset, smoke or oxygen mask microphones.

MIC/TEL SOCKET (3). Nato type, mounted one at each port and starboard console (P1 and P2) and one on P3 panel.

JACK BOXES (8). These incorporate telephone and microphone amplifiers, are concerned only with cabin/ground staff intercom and are located:-

One in port main wheel bay -
One at port lower edge of radome -
Underfloor radio rack -
Refuel point stbd -
Stbd engine stub -
Tail bullet port -
Fwd and aft stewards panels.

INTERCOM SWITCH. Roof panel. Marked 'Ground/Flight', this controls power to all jack boxes except the one beneath the nose and the two on the stewards' panels. Power is on at 'Ground', off at 'Flight'.

OXYGEN MASK MICROPHONES. These are automatically connected to the associated Station Box on release of the mask stowage cover.

SMOKE MASK MICROPHONES. These are connected to the associated Station Box when the mask is plugged into the oxygen point.

CENTRAL DISTRIBUTION UNIT. Flight deck radio rack. Function as per title, this unit also holds intercom amplifiers and circuits concerned with routeing of microphones to the selected system, and selection of receivers and transmitters.

CABIN STAFF HANDSET PANELS (2). These are fully described in the Cabin Address System. The telephone handset provides intercom with the flight deck and between the pantries.

POWER SUPPLIES. These are shown in FCS & Radio Power Supplies & Cooling. It will be seen that the flight deck system (Channel A) is supplied whenever the Essential DC Bus is live, and remains available until the aircraft batteries are exhausted. The two stewards' jack boxes and the nose jack box are always energised whilst there is an aircraft battery fitted.

GROUND CALL lamp. Roof panel, not part of CCS. Pressed to sound hooter in nose wheel bay.

FLIGHT DECK CALL switch. Adjacent to the nose jack box but not part of CCS. Sprung to off, the switch lights the 'Ground Call' lamp and sounds the chime in the port console.

VHF COMMUNICATIONS

GENERAL. Two complete Collins 618M - 2B installations form identical twin communication systems VHF1 and VHF2. Provision is made for a third system but the units are not fitted.

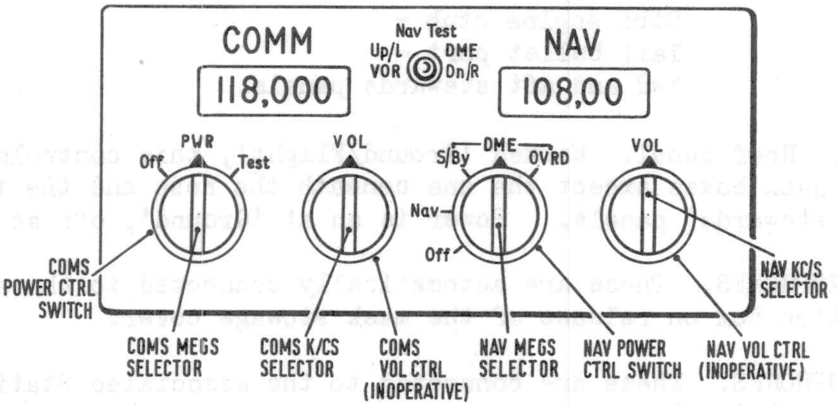

FIG.1 VHF COMM/NAV CONTROLLER

CONTROLLER (2). Two combined VHF Comm/Nav Controllers are mounted on the pedestal, VHF1 port, VHF2 starboard. Provision for VHF3 is made on the starboard console.

Fig.1 shows the controls and most of their functions.
The Comm side of each Controller allows selection of 1440 25 kc/s spaced channels within the band 116-151.975 mc/s. Of these, 720 channels with 25 kc/s spacing, within the band 118-135.975, are operative on aircraft post-Mod 23-A-104 (25 kc/s spacing).

Whilst (on pre-Mod aircraft) only the 50 kc/s spaced channels are operative it is arranged that if, for example, 132.425 or 132.475 is selected instead of 132.45, the latter will be obtained.

The 'Test' position of the power control switch disables the squelch circuits of the receiver to enable operation to be checked in the absence of incoming signals; receiver noise would be heard if serviceable.

The Nav side of the Controller is featured in Radio Nav Systems.

TRANSCEIVER UNIT (2). Third shelf down, flight deck radio rack. This incorporates frequency synthesiser, receiver and transmitter circuits.

The frequency synthesiser controls, with a single crystal, all 1440 receiver and transmitter frequencies.

The receiver provides all the 720 channels selectable at the controller. A squelch circuit cuts off all receiver noise when no readable signal is being received.

The transmitter unit provides all the 720 channels selectable at the controller. Output power is nominally 30 watts.

A 'Squelch Disable' button, 'Power' meter and switch, microphone and telephone sockets on the front of the unit are for maintenance purposes only.

AERIALS (3). Mounted as follows:-

Tx/Rx 1	Mid lower fuselage
Tx/Rx 2	Tailplane bullet top
Tx/Rx 3	Upper forward fuselage.

POWER SUPPLIES. DC only, shown in FCS and Radio Power Supplies & Cooling. VHF1 is fed from the Essential DC Bus so remains available until the aircraft battery is exhausted.

CABIN ADDRESS SYSTEM

GENERAL. The Cabin Address system allows announcements to be made and taped music to be played to the passengers, on loudspeakers throughout the cabin and toilets.

Announcements may be made at the flight deck Station Boxes as detailed in the Communications Control System section, or at the pantry Handset Panels. Announcements made at Handset Panels will override the tape player; those made at Station Boxes will override the Handset Panels and the tape player.

HANDSET PANELS. Two, one in each pantry, these are illustrated in the Cabin Crew Operations Manual. Each panel incorporates:-

A telephone handset for intercom use -
A microphone for cabin address use -

'Cabin Address' 'Pull to Talk' red lamp which comes on when pulled. It must be pushed in when the announcement is ended.
'Cabin Address' 'Hi/Lo' switch, on the forward panel only, varies the output level.
'Tape Repro' 'Low/Off/Hi' switch, forward panel only, allows two output levels, or none.
'Intercom' 'Flight/Pantry' switch. Set to 'Pantry' to speak to the other panel, 'Flight' for intercom with the flight deck in response to a crew call.
'Crew' green call lamp and 'Reset' button. The lamp comes on and the pantry chime sounds when the 'Stewards Call' lamp, on the flight deck roof panel, is pressed. The adjacent 'Reset' button puts out both 'Crew' lights.

Pressing the 'Crew' lamp sounds the flight deck chime and lights the 'Stewards Call' lamp. The 'Reset' button puts the light out.

'Stewards' green call lamps and 'Reset' buttons. Pressing the lamp on either panel brings the other on and sounds the chime. The 'Reset' button puts the light out.

AMPLIFIER. Mounted on the flight deck radio rack, third shelf down, this is an Ultra UA578 transistorised unit which amplifies the system inputs to the level required to drive the loudspeakers.

LOUDSPEAKERS. These are mounted in each passenger service unit beneath the hatracks, in the toilets and in the forward pantry. The latter, for monitoring purposes, is muted when the cain address is used at the forward panel.

POWER SUPPLY. This is shown in FCS & Radio Power Supplies & Cooling. The system is energised whenever the essential DC Bus is live and remains available until the aircraft battery is exhausted.

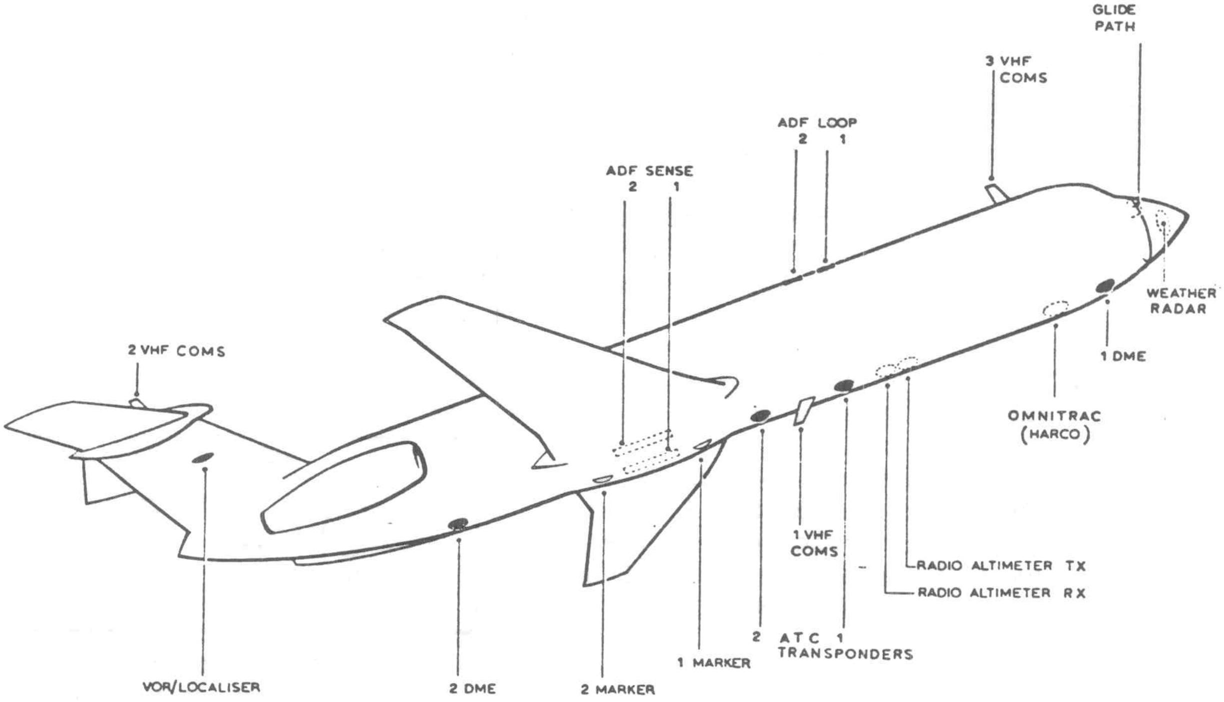

FIG.1 AERIAL LOCATION

COCKPIT VOICE RECORDER

GENERAL. The Fairchild Cockpit Voice recorder records all that is said and heard by P1 and P2 via their Station Boxes, including radio navigation call-signs and signals as well as voices. It records also all that is said within range of P1 and P2 boom microphones without Station Box selection or use of a transmit switch, the microphones being always live with respect to the recorder but without giving the noise in the telephones. An area microphone on the Controller allows a recording of any other sounds such as warning bells, horns or voices heard on the Flight Deck.

Four separate channels recorded on a 4-track closed-loop tape of 30 minutes capacity allows simultaneous recording of -

P1 Station Box selection
P2 Station Box selection
P1 & 2 live microphones
Area microphone

An erase head cleans the tape before it reaches the recording heads so that only the last 30 minutes soulds are recorded. It is not possible to play back the tape in the aircraft. after landing, the whole recording may be erased or kept as required.

CONTROLLER. Mounted on the pedestal, this has controls etc. as shown in Fig.1. The area microphone can be Seen on the left.

TEST button & meter. Open an HP cock. Press test button for 5 seconds. The meter should read in the green'GOOD' sector if all four channels areserviceable.

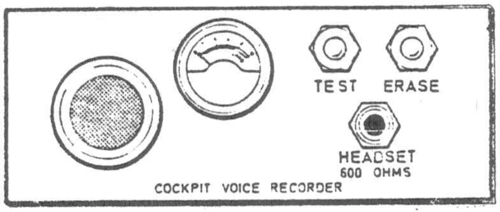

FIG.1 COCKPIT VOICE RECORDER CONTROLLER

HEADSET socket. this allows a 600 Hz note to be heard on pressing the Test button if all four channels are serviceable.

A 400 Hz note would be heard for 5 to 10 seconds after releasing the Erase button confirming that erasure is taking place.

/Cont'd. ...

The socket also allows monitoring of all recordings being made. The monitor output lags ¼ of a second behind the origin.

NOTE: NATO headset plugs will not fit the socket without an adapter.

ERASE button. Operative only on the ground, pressing the Erase button for two seconds wipes the tape clean within ten seconds of releasing the button.

VOICE RECORDER UNIT. This crash and fireproof unit is mounted in the starboard rear fuselage between stations 981 to 993.

POWER SUPPLY. Single phase 115V.AC, from 1 Main AC Bus via a DC relay which is closed when any HP lever is opened.

GROUND PROXIMITY WARNING SYSTEM

GENERAL. The Marconi-Lytton AA26101 GPWS gives audio and visual warning of -

Excessive rate of descent with respect to terrain (Mode 1).

Excessive rate of closure with terrain, with less than 26° of flap selected (Mode 2a).

Excessive rate of closure with terrain in landing configuration (Mode 2b).

Height loss after take-off or go-around (Mode 3).

Flight into terrain with less than 500 ft terrain clearance and undercarriage up (Mode 4a).

Flight into terrain with less than 500 ft terrain clearance and less than 26° of flap selected (Mode 4b).

Glide slope deviation (Mode 5).

The system is automatically inhibited during operation of stall warning or identification systems. Mode 5 warnings only, may be manually inhibited.

No warning can be given of approach to vertical terrain.

The system requires almost no management; it automatically selects the correct mode of operation. It can be switched off only by tripping the circuit breaker.

The probability of a false warning due to a system failure is small; a fault will normally inhibit the warnings.

Warnings are recorded on the Flight Recorder without identification of mode.

GPWS Unit. Carried in the flight deck radio rack this takes inputs of -

Radio height -

Barometric altitude rate -

Flap selector position -

Undercarriage selector position -

Glidepath deviation.

/Cont'd. ...

These are constantly manipulated so as to detect entry of an aircraft into a situation requiring a warning, as shown by the hatched areas in Figs 1 to 6. The unit then generates the audio and visual warnings.

Audio Warning. This is given in the headphones, in Modes 1 to 4, in the form of a rising note sounded twice, followed by the words 'Pull Up'. Only the words 'Glide Slope' are given in Mode 5. The warning is repeated continuously until the reason for the warning no longer exists. After three cycles, volume is reduced.

WARNING LAMPS. Two red, twin filament lamps marked 'GPWS Test' are mounted one in front of each pilot, on the edge of the glareshield, and have three functions.

Visual Warning. In the warning condition in Modes 1 to 4, the lights flash continuously until the reason for the warning no longer exists. Whilst the lamps are lit the words 'Pull Up' are shown. No visual warning is given in Mode 5.

System Test. Either lamp may be pressed to test the system on the ground only. If it is serviceable, both warning lamps flash and the audio warning 'Whoop whoop, pull up, glide slope' is given at reduced volume.

Mode 5 Warning Inhibition. Either lamp may be pressed to prevent Mode 5 warnings, provided the aircraft is above, or has been above, the upper limit of its Mode 3 warning envelope. The inhibition remains and is indicated as shown below, until either:-

The lamp is pressed again or -

The AC cb is tripped and reset or -

The aircraft goes below 100 ft R -

The system assumes Mode 3 on overshooting, the aircraft having descended below the upper limit of its Mode 3 warning envelope.

GPWS G/P Indicator. Mounted on the port and starboard instrument panels, this is a magnetic indicator which shows 'Inhib' whilst Mode 5 warnings are inhibited and 'Norm' otherwise.

BAROMETRIC RATE COMPUTER. Carried in the front equipment bay, this unit is supplied with static pressure and produces an output signal representing vertical speed.

POWER SUPPLIES. As shown in FCS & Radio Power Supplies, single phase 115V AC and 28V DC from Radio & Electronic AC Bus 1 and DC Bus 2 via GPWS cb's 483 and 442 respectively. The AC cb is colour coded orange.

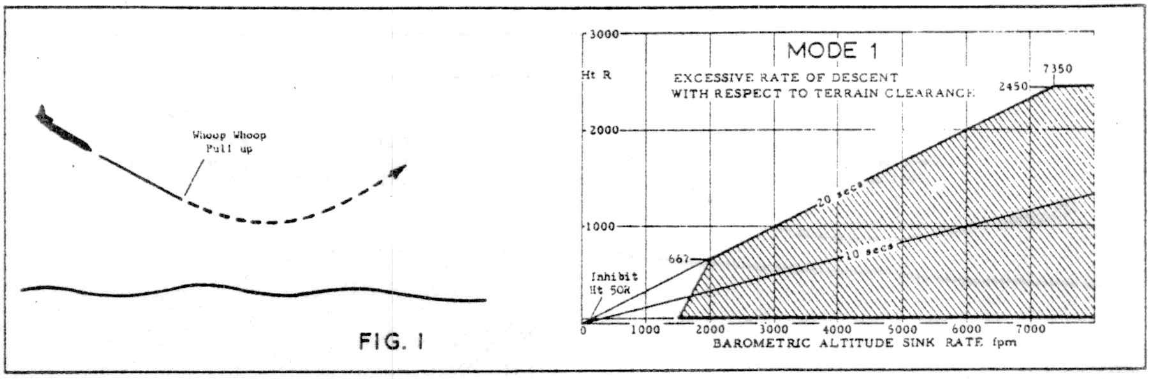

FIG. 1

THE 20, 15, 10 & 5 SECS
LINES SHOW THE TIME
LEFT BEFORE IMPACT
IF NO ACTION IS TAKEN

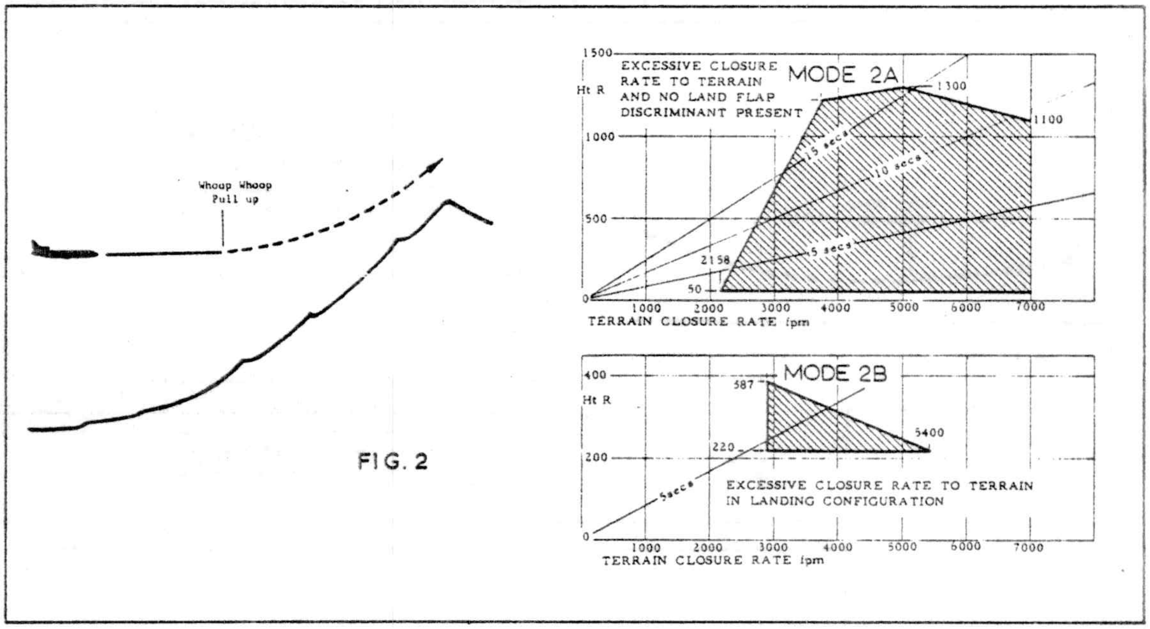

FIG. 2

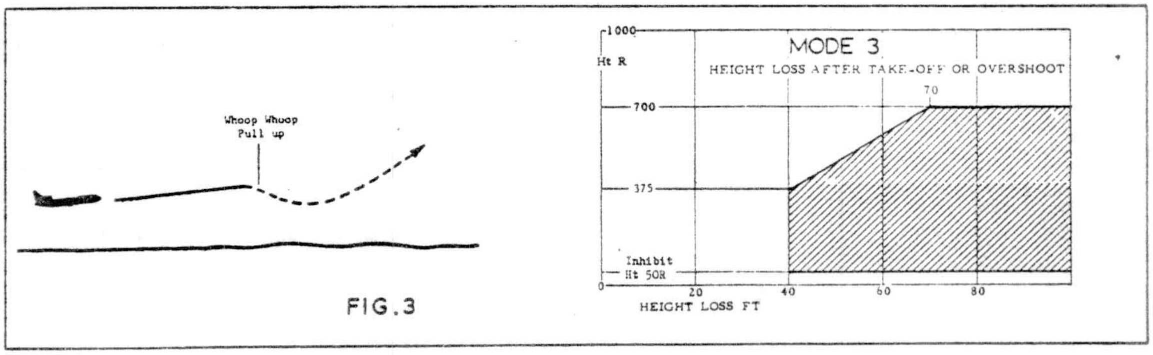

FIG.3

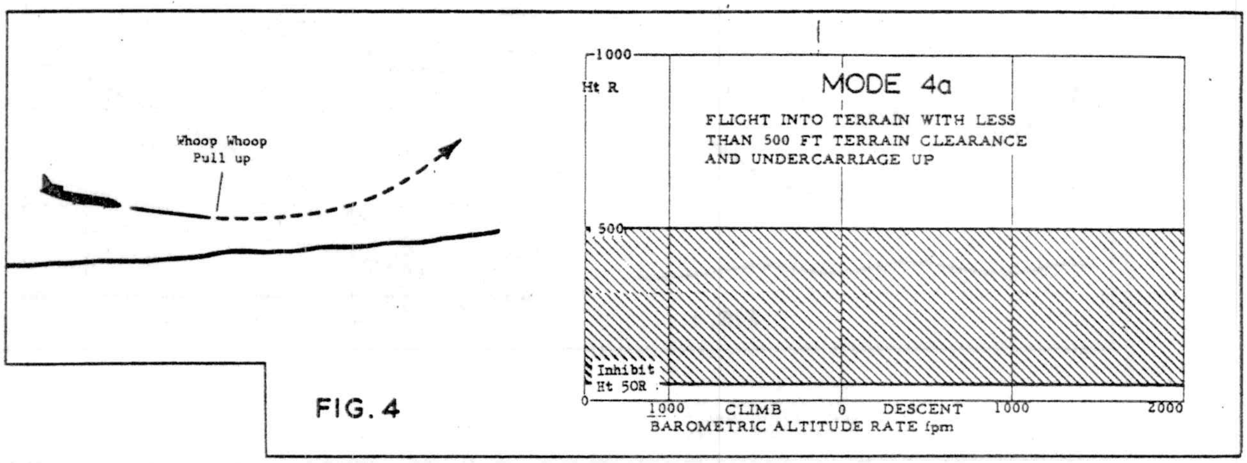

FIG. 4

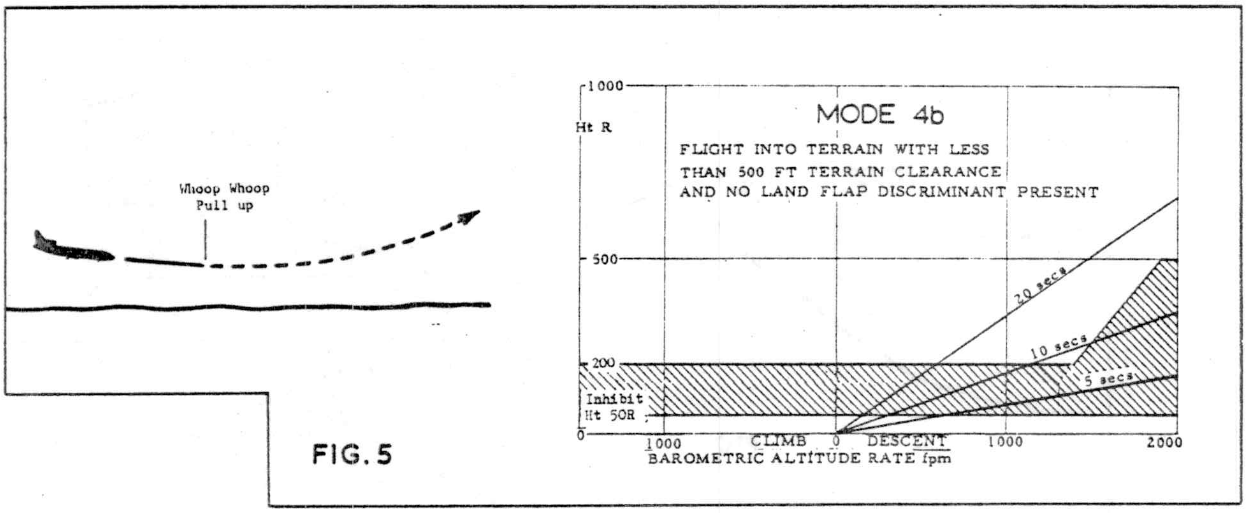

FIG. 5

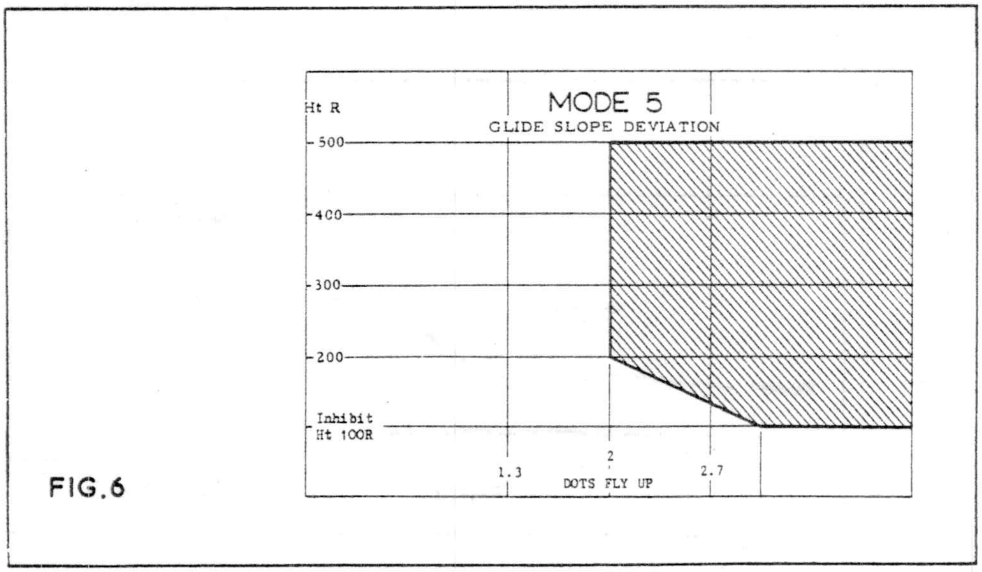

FIG. 6

ACCOMMODATION AND EQUIPMENT

GENERAL. The accommodation is divided into the flight deck, the passenger compartment with toilets and catering facilities, and, below the floor, freight holds and equipment bays. All this accommodation can be pressurised.

DOORS AND HATCHES

Forward Passenger and Service Doors

Both doors, similar in construction and operation, are held in the closed position by matching sets of lugs on the sides of the doors and frames: these lugs are disengaged by lifting the door in its frame. The door is prevented from rising by the engagement of a safety latch when in the closed position. To open a door, press down either the internal or external handle on the door; initial handle movement releases the safety latch and allows further handle movement to lift the door in its frame and disengage the lugs, and the door can then be swung outwards and forward (port) or aft (stbd). Each door swings parallel to the fuselage on a main hinge beam, and is latched in the fully open position; once a door starts to move outwards, it is held up by a latch. The external handle has to be pulled out of its recess to engage the operating mechanism, and the recess should be used as a hand hold when pulling the door open.

To close either door, pull outwards on the door release handle at the edge of the door to release the door-open latch, and swing the door into the closed position; as the door enters its frame, the up-latch is released, the door is guided down to engage the sets of lugs, and the safety latch engages automatically. When the safety latch engages, a yellow/black indicator flag appears behind an aperture in the furnishing panel. Before closing the port door the folding step must be stowed; this step can be extended below the port door sill by operating a lever behind the panel labelled 'Airstep' above the port pantry unit.

If either door becomes unlocked in flight, it is held in place by the pressure differential holding the door lugs against the matching frame lugs.

Rear Passenger Door

The rear passenger door in the pressure bulkhead aft of the toilets is opened by pushing the handle down and then swinging the door into the recess in the starboard toilet wall, where a spring-loaded catch in the floor holds it open. The catch is released by pressing on a tread-plate and the door can then be closed. Once closed, it is locked by returning the handle to the horizontal; a safety plate prevents the latches from being extended until the door has been fully closed.

Ventral Door

The ventral door comprises a door hinged at its forward end, integral steps, folding handrails and hinged bogy to compensate for varying ground attitude. The door is opened by pulling the interior handle out and turning it to 'Open', or by pulling the external handle down; this action opens the mechanical door lock, allowing the door to fall down against the damping action of a hydraulic jack. Neither handle will operate unless the other handle is in the stowed position.

To close the door from the inside, pull the operating handle from the stowed position and turn clockwise; this opens the hydraulic control valve to admit No.2 system pressure to the door jack, and closes a switch in the DC pump motor circuit. If No.2 system is already pressurised by the main or auxiliary pump, the door will be raised to the closed position. If No.2 system was de-pressurised:

1. On aircraft pre-mod E29A021, the DC pump motor will start running to supply hydraulic pressure to the door jack until the door closes and engages the mechanical up-lock, breaking the circuit to the DC pump by releasing the operating handle to the stowed position and closing the control valve.

2. On aircraft post-mod E29A021, the DC pump motor will not run unless the adjacent Air Stair Control switch is held up to 'Raise': the switch should not be released to 'Off' until the door is locked up.

To close the door from outside:

Do not attempt to raise the door by lifting the bogie.

1. Pull down the external operating handle, and lift the door to the closed position: the handle will return to the stowed position as the Up lock engages.
2. Check that the bogie folds to the stowed position as the door comes up.

On aircraft post mod E29A021, provided No.2 system is not pressurised, the door can be raised by:

1. Check the external handle in the stowed position.
2. Select the internal handle to 'Raise'.
3. Press the Airstair Control switch on the external APU control panel up to 'Raise', and hold to 'Raise' until the door is closed.

Freight Doors

A freight door is unlocked by pulling out the handle and turning it in the direction indicated, then pushing in the top edge of the door and allowing it to slide down under the restraint of the damper, until it reaches the stowed position below the fuselage, clear of the loading aperture. It is closed by disengaging the forward hook, lifting the door to engage the carrier rollers with the door frame tracks, pulling it up and out to the closed position, and then locking it by turning the handle clockwise. When the door is locked the handle is returned to its recess by spring action, and an indicator bearing two black diagonal lines is visible in an aperture near each of the two bolts. A second handle is fitted to the inner face of the door to enable it to be opened from within the hold, if necessary.

Hatches

Pressurised hatches on the underside of the fuselage give access to the electrical and radio bays. Each is locked and unlocked by a handle at its centre and when unlocked, can be pushed in, tilted, and withdrawn from the fuselage.

Door Sealing

The forward and rear passenger doors, service door and freight doors are surrounded by sealing tubes which are inflated by cabin pressure. Non-inflatable seals are fitted to the ventral door and radio and electrical bay hatches.

AIR STAIR CONTROL switches (2), post mod E29A021, one adjacent to the internal control handle for the ventral door, one on the external APU Control Panel. Spring-loaded to centre 'Off', press up to 'Raise'. Both switches are inserted in parallel to the DC Pump motor circuit; pressing either switch to 'Raise' will complete the circuit through the switch operated by the internal door control handle, energising the DC pump motor when the internal handle is moved to 'Raise'.

DOOR WARNING LAMPS (4), red, on left roof panel. Four double lamps, marked 'Front pass - Rear pass', 'Front Cargo - Rear Cargo', 'Service - Radio Bay', and 'Ventral - Electric Bay', the appropriate lamp coming on when a door is not properly closed.

The lamps are operated by microswitches at each door and hatch, the forward passenger and service door lamps in conjunction with the individual Door Locked lamps.

/Cont'd. ...

A press-to-test button beside the lamps enables the serviceability of the filaments to be checked.

DOOR LOCKED lamps (2), green on forward doors. A double lamp, marked 'Butt' and 'Hook', is carried on each door, operating in conjunction with the red door warning lamp. When the door is correctly seated, the butt lamp will come on. When the door safety hook has engaged, the hook lamp will come on. When both lamps come on the associated Door Warning lamp will go out; it will subsequently come on again if either butt or hook lamp goes out.

VENTRAL DOOR warning lamp (1), amber, beside interior selector handle. Marked 'Airsteps door unlocked', comes on when either the door uplock is disengaged or the selector handle is not in the stowed position.

STEWARD'S CONTROL PANEL L, forward pantry, port unit. Carries light switches, cabin address controls, and call lights, etc.

STEWARD'S CONTROL PANEL LA, rear vestibule. Carries light switches, cabin address controls, and call lights.

PANTRY CIRCUIT BREAKER PANELS (3), at each pantry unit. Carry circuit breakers and switches for pantry electrical equipment.

NOTE - The pantry electrical supplies are automatically isolated in flight when the air conditioning fan is operating, i.e. speed below 165 kt, undercarriage down.

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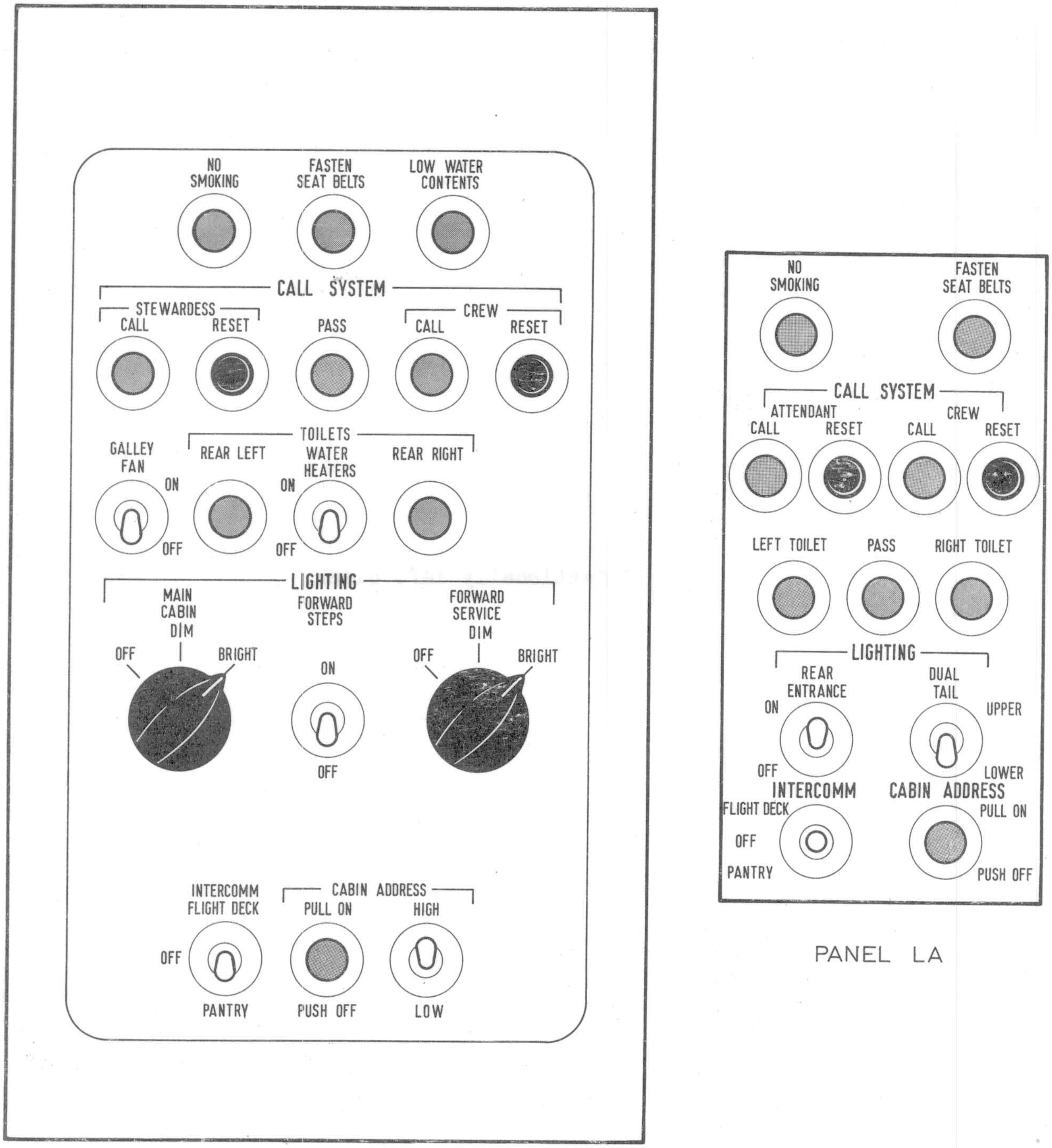
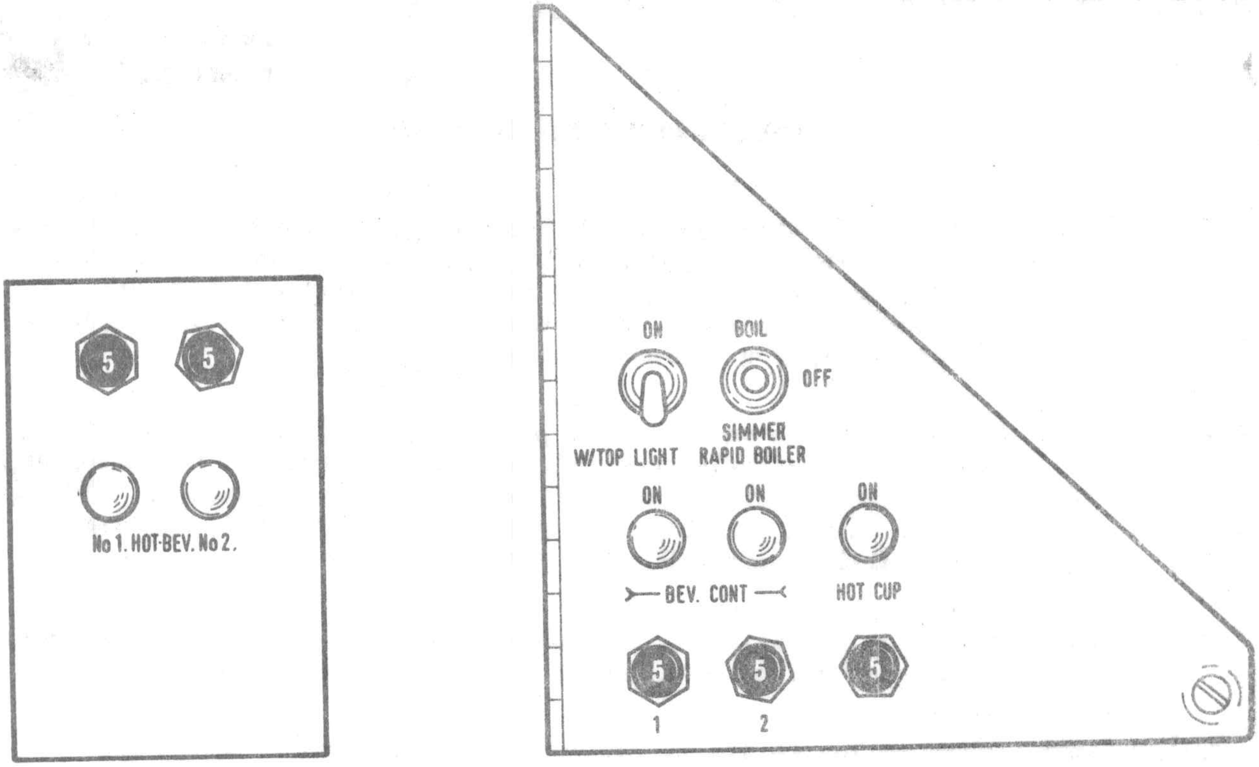


PANEL LA

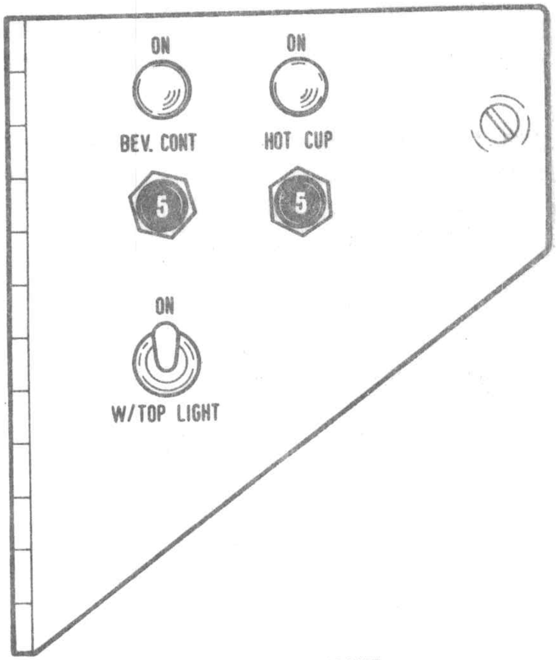
FIG.1 STEWARD'S PANELS

PANEL L



FORWARD PORT UNIT

FORWARD STARBOARD UNIT



REAR UNIT

FIG.2 PANTRY ELECTRICAL PANELS

CABIN AND ENTRANCE LIGHTING

ENTRANCE LAMPS. Lamps illuminating the forward passenger doorway step and the service doorway are controlled by switches on steward's panel L; that for the service door lamp has 'Off', 'Dim' and 'Bright' selections. Lamps above the ventral stairway and in the tailcone are controlled by a switch on steward's panel LA.

CABIN LAMPS. A rotary switch on steward's panel L controls fluorescent tubes in cabin and vestibule roof fittings in the 'Bright' position, and filament lamps in the same fittings in the 'Dim' position. If the AC supply should fail when the switch is at 'Bright', the dim lighting will automatically be energised.

READING LAMPS. Pre-set lamps in the passenger services units serve each seat; they are controlled by adjacent push-button switches.

TOILET LAMPS. Each toilet is lit by fluorescent tubes, two of which are permanently on, while the other four are lit when the door is bolted.

TOILET NOTICE. An illuminated 'Toilets Engaged' notice is fitted in the rear vestibule roof, 'Toilets' being permanently lit, whereas 'Engaged' is lit only when both toilet doors are bolted.

NOTE - When a 200/115V external supply is connected and the ground power CB is tripped, the cabin and toilet fluorescent lamps are lit, by-passing the switches. In addition, the hold lamps switches are connected to the ground power TRU.

SAFETY NOTICES

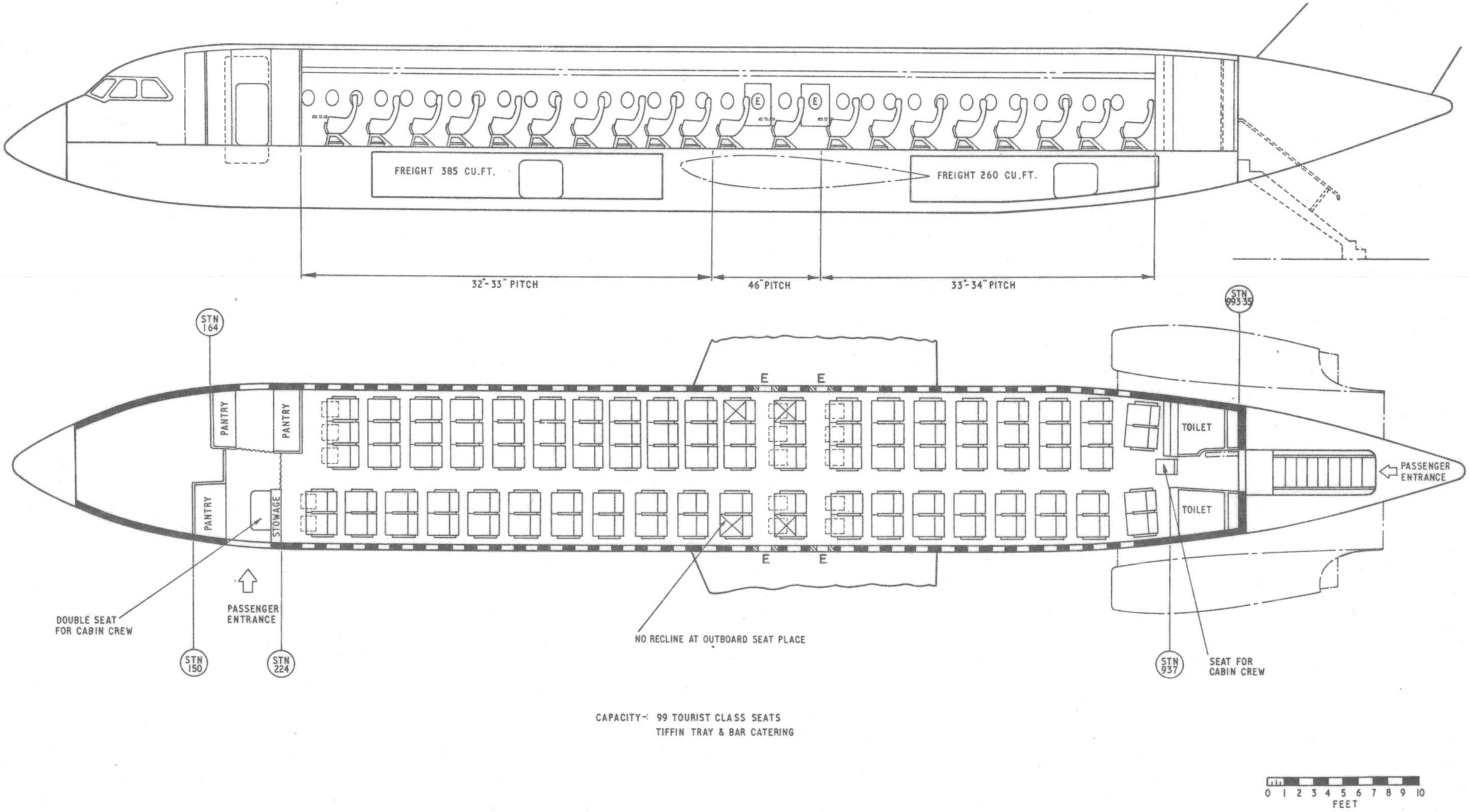
NO SMOKING and FASTEN BELT notices are fitted in the roof at the forward end and at the centre of the cabin, with warning lights on the steward's control panels L and LA, and are controlled by switches on the centre roof panel. When the 'Fasten Seat Belts' switch is set to 'On', the System 1 emergency lights are energised. The pantry chimes give audible warning when either notice is switched on.

RETURN TO SEAT notices are fitted in the toilets and are controlled by the 'Fasten Seat Belts' switch.

CREW CALL

CREW CALL lamps (2), green, on steward's control panels L and LA. Operated by the Steward Call button on the centre roof panel, which operates the chimes in the pantries at the same time. When the flight deck is called from the cabin, the blue lamp in the Steward Call button lights, and a chime sounds in the port console.

'E' DENOTES EMERGENCY EXIT WINDOW



CAPACITY-: 99 TOURIST CLASS SEATS
TIFFIN TRAY & BAR CATERING

SUPER 1-11

99 TOURIST CLASS SEATS
TIFFIN TRAY & BAR CATERING SERVICE

ISSUE	A

BRITISH EUROPEAN AIRWAYS
DRG. No. PA-E-2238

FIRE INDICATIONS

ENGINE FIRE DETECTION SYSTEMS

ENGINE FIRE warning lamps (2), red, in fire control handles on glareshield, marked '1', '2'. Two bulbs in parallel in each handle will light when the Firewire in Zone 1 of the associated engine is subjected to an excessive temperature. In addition, a red lamp will light in the head of the appropriate HP cock lever, provided it is not at Shut. The lamps will go out when the temperature falls below the critical value.

FIRE BELL, (1), on flight deck roof. Operated in conjunction with the engine fire warning lamps by the Firewire in Zone 1.

FIRE BELL ISOLATION switch (1), on centre instrument panel, marked 'Firebell pull to isol'. When pulled to isolate the bell, an amber lamp lights in the head of the switch. If subsequently pressed in the lamp will go out and, if a fire warning lamp is still lit, the bell will resume ringing.

ENGINE FIRE PROTECTION

FIRE CONTROL handles (2), on glareshield, one for each engine, marked '1', '2'. Pull and then turn clockwise for first extinguisher shot, anti-clockwise for second shot, as indicated on the handle. When pulled, the hydraulic and air isolation valves close and, if the HP cock lever is at 'Shut', the LP cock also closes.

FIRE EXTINGUISHERS (2). Two bottles, each containing 6lb of BCF (bromochlorodifluoromethane) are mounted on the port side of the rear face of the rear pressure bulkhead, and are accessible from the ventral stairway. Each bottle has two heads and can be discharged into Zone 1 of either engine. When a bottle has been discharged, an indicator pin protrudes from the head that has been fired.

FIRE BOTTLE DISCHARGE indicators (2), on centre roof panel, marked 1, 2. Latching magnetic indicators showing amber or 'FIRD'.

FIRE ACCESS panels (2), one on outboard side of each engine cowling, to provide extinguisher access to Zone 1 in the event of an engine fire on the ground; they are painted red.

FIRE EXTINGUISHER PRESSURE RELEASE indicators (2), on fuselage side below port nacelle fairing. Normally show a small green disc, but if the associated bottle has discharged as the result of excessive temperature a red bowl is visible; the foremost indicator is connected to bottle No.1, and the middle indicator of the three to bottle No.2.

APU BAY FIRE

DETECTION AND PROTECTION

APU FIRE warning lamps (2), red. One in fire control handle on glareshield, one on APU external control panel. Two bulbs in parallel in the fire control handle and one on the external panel will light when the Firewire in the APU bay is subjected to an excessive temperature, and the fire bell will also ring. The lamps will go out and the bell will stop ringing when the temperature falls below the critical value.

FIRE CONTROL handle (1), on glareshield, marked 'APU'. When pulled the LP cock closes and the electrical control is isolated, stopping the APU. After waiting ten seconds to allow the rpm to fall, the handle can then be turned in either direction to discharge the extinguisher.

FIRE SHUTDOWN switch (1), on APU external control panel. Up 'Normal', down 'Fire'. When set to 'Fire' the LP cock closes, the electrical control is isolated to stop the APU, and the Fire Bottle switch is electrically armed.

FIRE BOTTLE switch (1), on APU external control penal. Up off, down 'Extinguish'. When set to 'Extinguish' after the Fire Shutdown switch has been set to 'Fire', and not otherwise, the fire bottle will discharge.

MANUAL-FIRE AUTO switch (1), on centre roof panel. When in either position the fire control handle and the fire switches on the external panel function normally. When at 'Fire Auto' (down) these are supplemented by an automatic extinguishing circuit which, on receipt of a fire warning, shuts down the APU and, after a 12 second delay, fires the extinguisher bottle.

FIRE EXTINGUISHER (1). One bottle, containing 21b of BCF, is mounted on the fin frame, port side. An indicator pin protrudes from the head of the bottle when it has been fired.

A spare bottle is carried in a stowage on the starboard shear deck deck behind the ventral stairway furnishing panel. When it is used, this must be recorded on the Carry Forward Defect Sheet of the Technical Log, giving the serial number.

FIRE BOTTLE DISCHARGE indicator (1), on centre roof panel, marked 'APU'. A latching magnetic indicator showing amber or 'FIRD'.

FIRE ACCESS panel (1), in APU access panel under tailcone. Provides extinguisher access to the bay in the event of an APU fire on the ground, or pressure relief in the event of an explosion in the bay. It is painted red.

FIRE EXTINGUISHER PRESSURE RELEASE indicator (1), the rearmost of the three on the fuselage side below the port nacelle fairing. Normally shows a small green disc, but if the bottle has discharged as the result of excessive temperature a red bowl is visible.

FUSELAGE FIRE PROTECTION

PORTABLE EXTINGUISHERS. For locations, see Crash and Survival section of Vol.I - Flight Management.

CO_2 (1), for use on electrical or fluid fires. Discharge horn can be detached from swivel mounting for use in confined spaces.

Water glycol (2), for use on fires which do not involve electrical equipment or inflammable liquids.

SMOKE GOGGLES (1), in stowage on port console. To be used by the third crew member, if carried, if the flight deck should fill with smoke or fumes. Worn with an oxygen mask, and will fit over spectacles if necessary.

TEST CONTROLS

FIRE HANDLE test switches (3), on centre instrument panel. Spring-loaded off (up), down 'Test'. Marked 'No.1', 'APU', 'No.2', left to right. When a switch is set to 'Test', the fire bell rings and the appropriate fire warning lamps illuminate if the detection system is serviceable. When No.1 or No.2 switch is held at Test, the lamp in the appropriate HP Fuel lever will also light, unless the lever is at 'Shut'. Before operating the APU test switch, the APU Manual-Fire Auto switch must be at Manual (when at Fire Auto the test switch is isolated).

The test switches must not be used in flight in case the Firewire temperature is so high as to prevent the system from re-setting.

GROUND HANDLING

PITOT HEAD COVERS

Pitot head covers are to be fitted as soon as possible after landing, except during a quick transit or turnround during which one pilot remains on board, and are to remain fitted until removed during the PDC for the next flight.

UNDERCARRIAGE GROUND LOCKS (3), in stowage in port console.

Undercarriage ground locks are to be fitted when towing or parking the aircraft, in the event of reported unserviceability of the downlock mechanism, and when specified in the Maintenance Schedules. Their use is otherwise discretional, but should be considered during extended aircraft unserviceability. Whenever ground locks are fitted only those carried on the aircraft are to be used.

TOWING

The aircraft can be towed or pushed, using a tow-bar connected to the nose undercarriage leg, after disconnecting the nosewheel torque links. In emergency, towing either forward or backward can be done using towing bridles attached to the main undercarriage legs, with one towing vehicle on each bridle. When towing bridles are in use, the aircraft must be steered by means of a steering arm connected to the nose undercarriage towing lugs, and the main undercarriage fixed doors must be removed.

PARKING PROCEDURES

Following the Closing Down drill, when no engineering coverage is available:-

1. Ensure that the aircraft is headed into wind, wherever possible, and that the nosewheels are centralised.
2. Place chocks forward and aft of the mainwheels. Release the parking brake.
3. Fit the undercarriage ground locks. (See Fig.1).
4. Close all windows and interior doors.
5. Ensure that all electrical services are off.
6. Secure all exterior doors and fit any access panels previously removed.

/Cont'd .....

7. Fit plugs, bungs, and protective covers, if available.
8. If the air temperature is likely to fall below freezing point, drain the water system.
9. If the aircraft is to remain parked for more than 48 hours it must be moved at intervals to prevent the formation of flat spots on the tyres.

MOORING PROCEDURE

Winds exceeding 65 kt:

1. Carry out the Parking Procedure.
2. Moor the aircraft by the three undercarriage legs and the eyebolt under the rear fuselage. (See Fig.2).
3. Remove servicing platforms, steps, etc., to a safe distance.

Mooring should be done with 3½ in. manilla rope to British Standard 2052 Grade 1, leaving sufficient slack for shrinkage in wet weather. When fixing the ropes to the landing gear, suitable padding, which should be coloured red, must be used to prevent chafing of the ropes and damage to hydraulic pipes and other components.

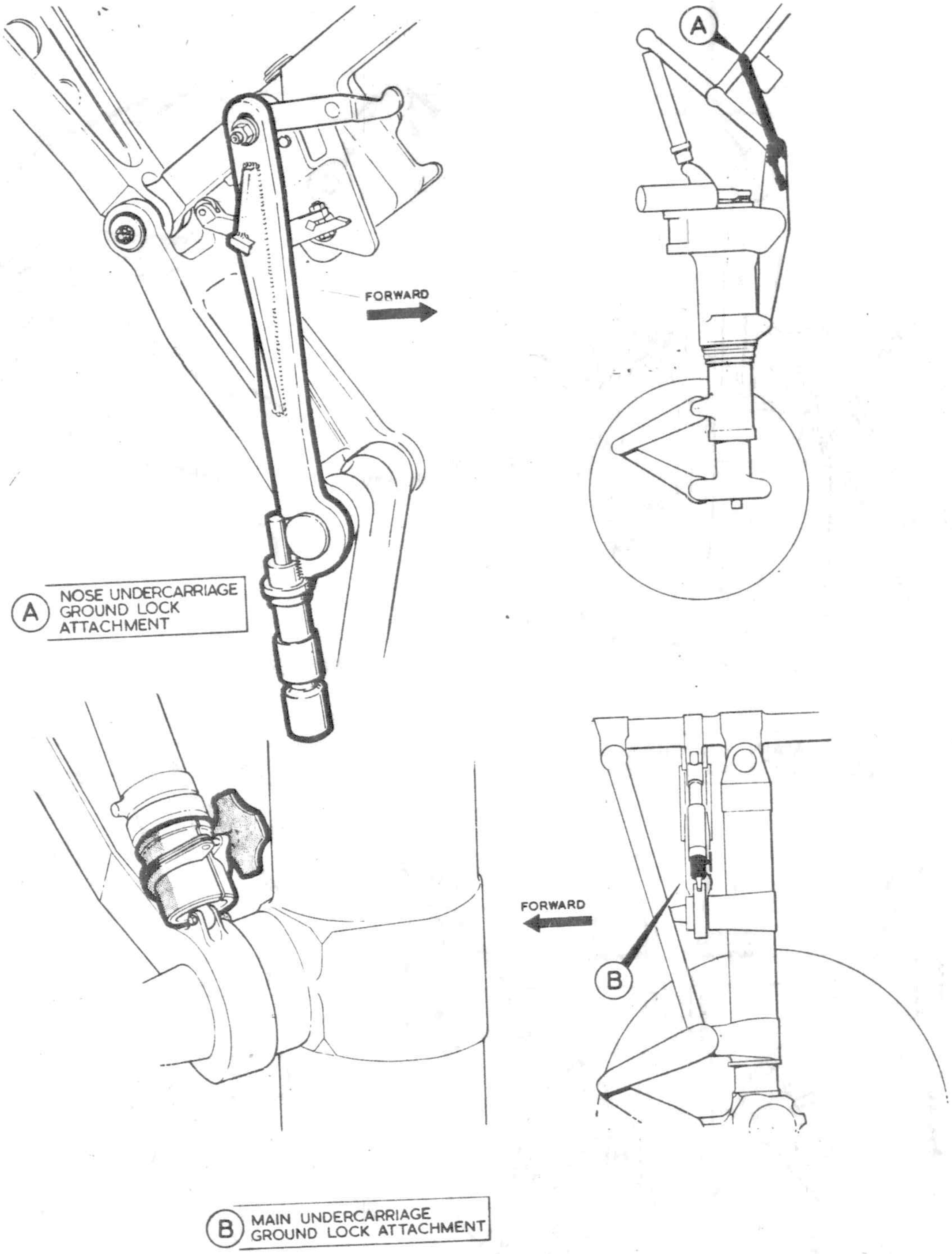

A
FORWARD
A
NOSE UNDERCARRIAGE GROUND LOCK ATTACHMENT
FORWARD
B
B
MAIN UNDERCARRIAGE GROUND LOCK ATTACHMENT

FIG.1 UNDERCARRIAGE GROUND LOCKS

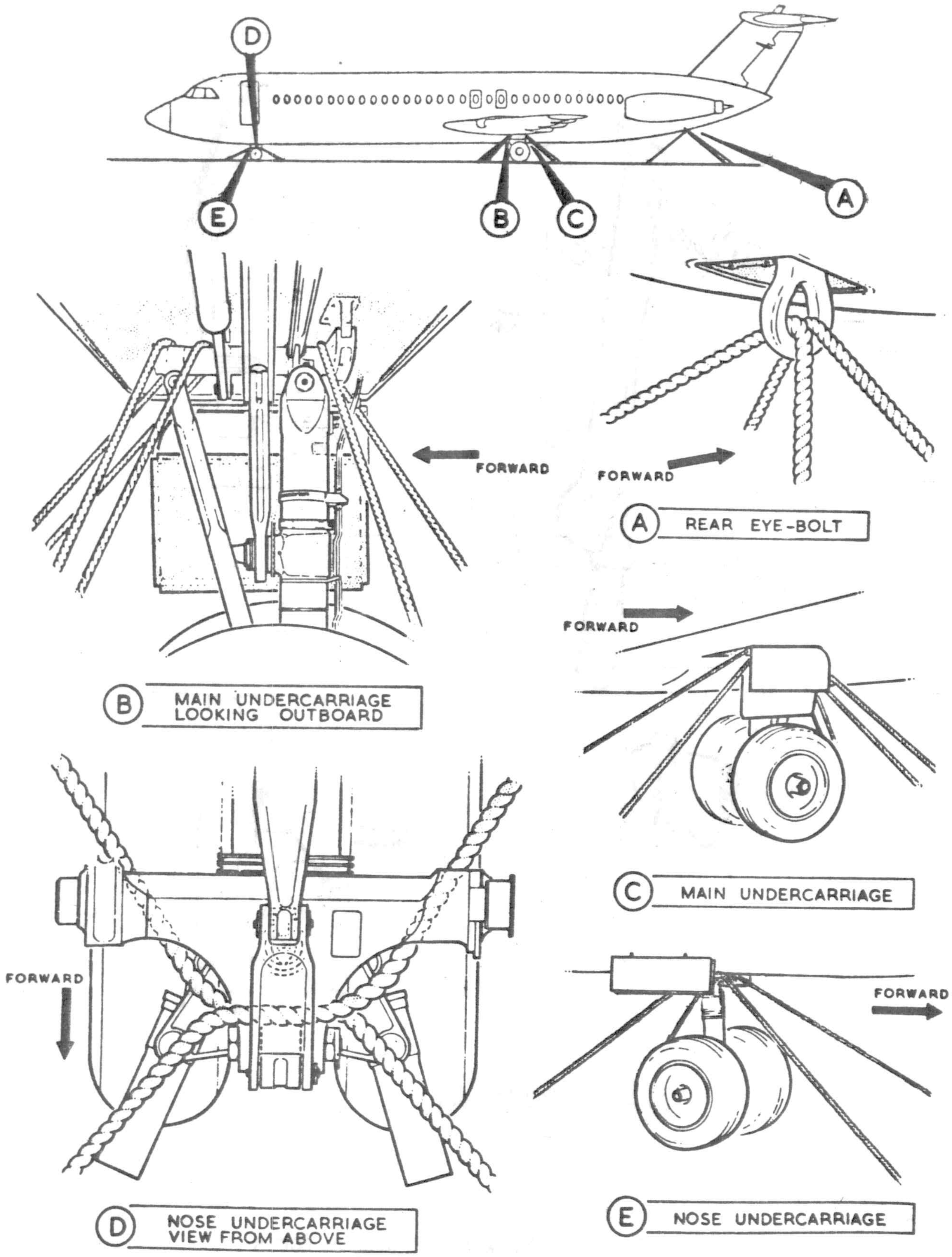


FIG.2 MOORING

British airways **APPROVED TECHNICAL PUBLICATION AMENDMENT**

This revision complies with ANO Article 24 BCAR A6-7 CAP 360 and Technical Services Procedure T-DON-02-05

Approved Design Signatory F. Archer

Insert this sheet at front of manual. Destroy previous issue. Complete Amendment Record Sheet after amendment incorporation.

Issued by: TECHNICAL INFORMATION SERVICES, BRITISH AIRWAYS, G2, TBA, S401,
LONDON (HEATHROW) AIRPORT, P.O. BOX 10, HOUNSLOW, MIDDLESEX.

SUPER 1-11 OPERATIONS MANUAL VOL.1 - TECHNICAL
(Approved Technical Publication No.872)

June 1988

ALLOWABLE DEFICIENCIES AMENDMENT NO.96

This complete section of the Technical Manual is now obsolete, and is superseded by the 1-11 Allowable Deficiencies Manual, which is issued to Engineering and carried on the aircraft.

Therefore will all Manual holders please remove and discard the whole of the Allowable Deficiencies section from the Technical Manual.

ALLOWABLE DEFICIENCIES

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ALLOWABLE DEFICIENCY LISTS

INTRODUCTION

These Allowable Deficiency Lists are produced against a background of British Airways flying staff and ground staff training, operating procedures, internal instructions, aircraft and airborne equipment modification state, etc., and for these reasons are not applicable to operations not controlled by British Airways or to aircraft not to British Airways standard.

POLICY

As a general policy it is intended that the Allowable Deficiency List be applied by Captains and Engineers so as to permit an aircraft to continue flying to schedule, with partially inoperative systems, until rectification can be accomplished.

Rectification will be planned within the scope of the Defects Carry Forward system which allows the aircraft to remain safely on service until it reaches a time and place at which rectification action can be planned to take place consistent with the best use of aircraft downtime and manpower, taking into account the operational significance of the defect.

The success of the policy depends on Captains endeavouring to operate the aircraft until it reaches the terminal at which repair is planned, provided it is safe to do so.

Items which do not affect the airworthiness of the aircraft such as galley equipment, entertainment systems, passenger convenience items etc., are not included.

CATEGORISATION

$\boxed{\text{P}}$ annotation indicates items of performance or operational significance which may be wholly or partially inoperative to the Captains discretion.

NOTE: Judgement is necessary in all cases in relation to multiple discrepancies.

SAFETY

Typical precautions to be taken prior to the release of an aircraft to a reduced equipment standard are:-

Both Engineer and Captain must be fully acquainted with the proposed limitation.

Consideration must be given to isolating defective equipment from the remainder of the system by removal of fuses, blanking of pipelines, locking selectors off or such other action as may promote safety.

Wherever appropriate unserviceable equipment in the aircraft must be clearly and unmistakably labelled as defective. In the case of recording items the label must be so fitted that no reading can be taken during aircraft operation.

All action taken must be clearly entered in the Technical Log and certified by the individual concerned.

It is emphasised that the existence of these lists in no way absolves the Captain and Engineer from ensuring that an aircraft is safe for flight, as specified in ANOs.

GENERAL

Although every effort is made to issue Allowable Deficiency Amendments simultaneously to Operations Manual Vol.1 and the 'ALLOWABLE DEFICIENCY MANUAL', instances may occur where one is received before the other. In these circumstances if this be queried between Captain and Engineer, it should be noted that the page bearing the higher AD number (at the foot of the page) contains the latest information.

Captains should make every endeavour to radio details of defects to Stations before arrival, as this can greatly assist in minimising subsequent late departures by immediate positioning of spares and labour.

It should be appreciated that occasions may arise where equipment not included in these lists can be unserviceable, without the responsible Engineer considering that the aircraft is unserviceable for flight. The existence of these lists does not preclude the Captain from accepting the aircraft under such circumstances.

In order to keep these lists live, Staff should make every endeavour to advise Manager Quality, through Line Management, additional items which they consider should be included and the occasions when they have been unable to conform with the published listings.

AIRFRAME

1. Rudder pedal adjustment	If locked to individual requirements, acceptable inoperative.
2. Crew seat adjustment	If locked to individual requirements, acceptable inoperative.
3. Door warnings system	See Electrical section.
P 4. Passenger windows	Flight is permissable with the failure of an inner or outer panel providing the following conditions are complied with: The flight is UNPRESSURISED, (a) Outer panel failure; (1) Only one Outer Panel has failed. (2) The associated Inner Panel is Serviceable. (3) It must be ensured that no loose pieces of failed Window Panel remain which could be ingested. (4) The failed Panel must be aft of the Angle of Attack Sensor Vanes. (5) Provision must made for moving passengers from the vicinity of the Window if the noise level is unacceptable. (6) The desiccator pipe at the failed window is blanked off. (b) Inner Panel failure, (1) The associated Outer Panel is serviceable.
5. Gear indicators (mechanical)	Not essential, providing electrical system serviceable.
6. Gear indicators (electrical)	(a) Providing mechanical indicators serviceable, acceptable inoperative. (b) Either filament acceptable inoperative.
7. Gear ground locks	Not essential.
8. Gear audible warning	See Electrical section.

P	9.	Flaps position indicator	Not essential, refer Flying Controls Abnormal Management.
	10.	Tailplane position indicator (electrical)	Not esential. Trimwheel index to be checked against tailplane position before flight.
P	11.	Lift dumpers and spoilers	Acceptable inoperative. Refer Flight Handling Special Procedures
	12.	Lift dumper indicators	Not essential.
	13.	Undercarriage selector lever lock solenoid	Providing manual override serviceable, acceptable inoperative.
P	14.	Windsreen wipers	(a) Either acceptable inoperative. (b) LH serviceable if rain forecast.
	15.	Electric elevator trim gauge	Provided trim tab (port elevator) is neutral before flight, acceptable inoperative.
	16.	Elevaor gust damper engaged lamp	Not essential. If necessary check PCU to ensure damper engaged.
P	17.	Rudder fine steering	Acceptable inoperative.
	18.	Ventral airstairs	Powered operation not essential.
	19.	Static dischargers	Providing one serviceable at each wing tip and each tailplane tip and two diverters serviceable at the radome probe discharger, the remainder acceptable ineffective.
	20.	Undercarriage static earthing wires	Not essential.

/Cont'd ...

P 21.	Aileron gust dampers	Acceptable inoperative providing: (a) Function is satisfactory as aileron stop. (b) Aircraft is not taxied in tail-winds above 31 kt. (c) Ailerons (not control column) are restrained if parked in gusty conditions.
22.	Standby steering accumulator air pressure gauge.	See Hydraulic section.
23.	Brake accumulator air pressure gauge.	See Hydraulics section.
24.	Take-off configuration warning	Providing individual indications serviceable, not essential.
25.	Main U/C outboard leg fairing and fixed leg fairing (NOT MAIN DOORS)	Either one only acceptable removed from one or both undercarriage.
26.	'Emergency Elevator Selected' indicator.	Acceptable inoperative.
27.	Flight Deck Crew Harness	Providing pilot able to adjust his harness into secure position from which he can reach all relevant controls, one lock facility (manual or inertia) acceptable inoperative at each pilot position.
28.	(a) Nose and underwing external intercom panels (b) Hydraulic service access door (c) Rear Toilet service door (d) Hydraulic compensator box door (below fin LH side) (e) Tail light cone (f) Tail steady point access door) (g) Rear water service door (h) Flap root end fairing hinged door	Isolated panels acceptable removed.

P	29.	Elevator control linkage fairings at inboard end of tailplane.	Providing icing not forecast and no snow or slush on runway one only acceptable removed.
P	30.	Elevator hinge access door	Providing icing not forecast and no snow or slush on runway one only acceptable removed at each hinge position.
P	31.	APU fire control access panel	Providing APU not used in flight, acceptable removed.
	32.	Fuel control access door	Providing fuelling MASTER SWITCH selected OFF, acceptable removed.
P	33.	Front Windscreen	(a) Outer glass failure acceptable, provided loss of vision acceptable. Max 210 kt below 5,000 ft. (b) Inner glass failure acceptable, provided loss of vision acceptable.
P	34.	DV Window or Sidescreen	(a) Outer glass failure acceptable. (b) Middle glass failure acceptable, provided aircraft not pressurised. (c) Inner glass failure acceptable.

P 35. Passenger Emergency Exits and Escape Slides

Operation with one exit or escape slide inoperative is permitted to allow the aircraft to return to the nearest base where the fault can be rectified provided:-

(a) The maximum number of passengers carried is as follows:

Inoperative exit	Max. No. of passengers
Ventral airstair or airstair door	109
Port or starboard forward door	67
Port or starboard slide	67
Port or starboard forward overwing exit	87
Port or starboard rear overwing exit	102

(b) the inoperative exit is secured closed and is labelled 'No Exit'.

NOTE: The 'No Exit' labels are stowed in the flight deck documentation wallet.

(c) 'Exit' or 'Emergency Exit' signs associated with the inoperative door and signs directing passengers to it are obscured, including the appropriate exit identifiers of the floor proximity emergency lighting system.

(d) An announcement is made to the passengers before take-off and landing to draw their attention to the inoperative exit.

36. Flaps	Providing locked in 'UP' position acceptable inoperative. Commercial passengers and cargo prohibited. (Refer Flight Handling Special Procedures).
37. Flap shaft fail warning system	Provided both primary and secondary flap drive systems checked serviceable, acceptable until return to LHR.

Cont'd. ...

AIR SYSTEM

P 1. Primary Mains

(a) Providing APU supply operative and altitude limited to 17,000 ft, either LH or RH system acceptable inoperative. Flight should not be commenced if it is anticipated that icing conditions will be experienced.

See Abnormal Management - Air conditioning.

(b) Providing APU supply operative and altitude limited to 10,000 ft, both acceptable inoperative. Aircraft must remain clear of icing conditions.

(c) Providing unpressurised flight facility serviceable, not essential.

NOTE 1: Not ex LHR or TXL.

NOTE 2: Water/toilet flush systems operated by primary air.

NOTE 3: These altitude limitations are lower than applied following system failure in flight.

P 2. Air Conditioning system

(a) Either LH or RH system acceptable inoperative. Altitude limited to 17,000 ft.

(b) Providing unpressurised flight facility serviceable, not essential. Altitude limited to 10,000ft.

P	3.	Air conditioning master valve	Providing visually checked closed, one acceptable inoperative.
P	4.	Isolation valve	Providing visually checked closed, one acceptable inoperative. Refer item 1 (Primary Mains Air System).
P	5.	Pressure reducing valve	Providing visually checked closed one acceptable inoperative. Refer item 1 (Primary Mains Air System).
	6.	Radio cooling fans	One acceptable inoperative.
	7.	Cabin altimeter	Providing cabin differential gauge serviceable, not essential.
	8.	Cabin differential gauge	Providing cabin altimeter serviceable, not essential.
	9.	Cabin rate of climb indicator	Not essential.
	10.	Cabin altitude warning light	Not essential.
P	11.	Heat exchanger cooling fan	If air conditioning not used on ground, acceptable inoperative. See Abnormal Management
	12.	Auto temperature control system	If TCV position indicator serviceable, not essential.
	13.	Manual temperature control system	Providing auto temperature control serviceable, not essential.
	14.	Temperature control valve position indicator	If auto temperature control system serviceable, acceptable inoperative.
P	15.	Primary temperature control valve	Providing system not used acceptable inoperative. Refer item 1 (Primary Mains Air System).
P	16.	Auto pressure control	Not essential provided MANUAL control acceptable.

P	17.	Air crossfeed valve	Providing both air conditioning systems serviceable, acceptable inoperative failed shut.
	18.	Ram air valve	Providing both air conditioning systems operative, acceptable locked shut.
	19.	System temperature gauge	Providing associated mains pressure gauge operative, not essential. See also item 28 .
	20.	Mains pressure gauge	Providing associated system temperature gauge operative, not essential. See also item 28.
	21.	Cabin temperature gauge	Not essential.
	22.	Mains fault annunicators	Not essential.
	23.	Air crossfeed valve magnetic indicator.	Not essential.
	24.	Fan inlet shutters	Acceptable locked shut.
	25.	Discharge valve position	Providing cabin ROC indicator serviceable, acceptable inoperative.
P	26.	Discharge valve manual dump control	Acceptable inoperative OPEN for unpressurised flight.
	27.	Cold Air Unit overheat thermostats	Either one acceptable inoperative for each cold air unit.
	28.	System temperature and mains pressure gauges	Providing wing/tail antice temperature gauge serviceable, acceptable inoperative.
	29.	Stub duct fail detector system	Providing both air systems serviceable 'FAILURE ON TEST' acceptable (Auto shut down available from remaining detectors).

APU

P	1.	APU	Providing both hydraulic EDPs, both main electrical and both main air systems operative, acceptable inoperative. See Special Procedures, Flight Handling. NOTE: Consideration must be given to facilities at terminating airfield.
	2.	Elapsed time indicator	Record time in log. Not essential.
	3.	Low oil pressure warning	Not essential. NOTE: Except in emergency APU not to be used in flight.
	4.	EGT gauge	Providing both thermostats serviceable, not essential.
	5.	LP pump	Not essential.
	6.	Fuel valve position indicator	Not essential.
	7.	Start-run indicator	Not essential. Check alternator frequency and air delivered.
P	8.	Air delivery valve	Providing 'shut' acceptable inoperative. NOTE: Refer APU, item 1.
	9.	Tail cone overheat shut-down facility	Providing APU oil consumption less than 0.12 pts/aircraft flying hour, acceptable inoperative.
	10.	Operation of APU as essential equipment. Refer Vol.1 Flight Management - Engines (d); Flight Handling - Special Procedures.	Water drain check of left wing tank must be carried out before each take-off.

BRAKES

P	1.	Brakes	Any deficiency providing (a) At least 3 wheelbrakes operative with anti-skid AND (b) At least 3 wheel brakes operative through the handbrake. Refer Flight Handling Special Procedures.
	2.	Auto-brake system (Main wheel braking during U/C retraction).	Not essential.
	3.	Hytrol test	Providing Hytrol system operation satisfactory at last landing, acceptable inoperative.
	4.	Hytrol annunciation	Providing Hytrol system operation satisfactory at last landing, acceptable inoperative.
	5.	Parking (LOCK ON) facility	Providing handbrake system operative, not essential.
	6.	Brake temperature gauge	(a) Temperature indications from any one brake unit acceptable inoperative. (b) Providing overheat precautions observed at each transit, not essential.
	7.	Foot/hand brake accumulator indication	Providing pressure satisfactory at accumulator servicing gauge not essential.
	8.	Foot brake pressure	Providing foot brake accumulator indication and hand brake pressure indication serviceable, not essential.
	9.	Hand brake pressure indication	Providing hand brake accumulator indication and foot brake pressure indication serviceable, not essential.

DE-ICING

P	1.	All systems (except pitot heads and incidence vane heaters)	Not essential unless icing is anticipated.
	2.	Ice observation lights	Not essential.
	3.	Ice detector	Providing ice indicator serviceable, not essential.
	4.	Ice indicator	Providing ice detector serviceable, not essential.
P	5.	Engine anticing air control valves	Providing shut, one per aircraft acceptable inoperative. NOTE: This will ensure adequate protection except in severe icing conditions.
	6.	Pitot head ammeters	Not essential.
	7.	Windscreen heating	(a) Overheat cycling acceptable. (b) Side panels acceptable inoperative. (c) Starboard Windscreen heating acceptable inoperative. Max 210 kt below 5,000 ft. (d) Port Windscreen heat acceptable inoperative, providing icing not forecast and starboard windscreen serviceble. Max 210 kt below 5,000 ft.
	8.	Engine anticing pressure gauge	Not essential. On selection above 10,000 RPM, check LP RPM fails approximately 150.
P	9.	Q-feel pitot heater	Either one acceptable inoperative provided icing or precipitation (OAT below + 10°C) not forecast enroute. Defect must not be carried forward after nightstop at LHR or TXL. NOTE 1: Refer Flying Controls Abnormal Management. NOTE 2: Q-feel water drains to be checked before departure.

ELECTRICAL

P	1.	Generator cooling system	Provided associated generator not selected on ground, not essential.
P	2.	CSDS	One acceptable inoperative provided air motor operative, CSDS connected for start, and APU serviceable for in-flight use. Refer Flight Handling. Special Procedures.
P	3.	AC generator	Providing both hydraulic EPDs serviceable, one acceptable inoperative. If a main generator then APU must be serviceable for in-flight use. Refer Flight Handling, Special Procedures; APU Allowable Deficiencies 8A, item 10.
	4.	KVA meter	Providing associated AC voltmeter or frequency meter serviceable, not essential.
	5.	AC voltmeter	Providing associated KVA meter or frequency meter serviceable, not essential.
	6.	Frequency meter	Providing associated KVA meter or AC voltmeter serviceable, not essential.
	7.	TRU ammeter	One may be inoperative provided associated TRU is known to be giving an output.
	8.	Battery ammeter	Provided both TRU ammeters are serviceable, acceptable inoperative.
	9.	DC voltmeter	Provided battery ammeter serviceable, not essential.
P	10.	Instrument lighting (flight deck display)	Adequate for projected service.
	11.	Generator fail warning lamp	Providing associated KVA meter operative, not essential.

Cont'd....

ELECTRICAL Cont'd.

	12. Door warning lamps	Provided door verified locked by visual inspection, acceptable inoperative.
	13. Domestic lighting	Adequate for projected service.
P	14. Landing lamps	(a) Not required in daylight. (b) One acceptable inoperative by night provided that all other landing lamps and runway turn-off lamps are operative.
	15. Nose landing lamp	Not required in daylight. Acceptable inoperative by night provided port and starboard landing lamps serviceable.
	16. Runway turn-off lamps	Not required in daylight. Acceptable inoperative by night provided port and starboard landing lamps serviceable.
	17. Servicing (hold) lamps	Not essential. NOTE: Nosewheel bay light required for nose undercarriage mechanical indicator.
P	18. Anti-collision lamps	Not essential for day flights, all essential for night flights.
P	19. Navigation lamps	Not essential for day flights, all essential for night flights.
	20. Crew call system	(a) Lamps - providing CA system serviceable, acceptable inoperative. (b) Audible - providing CA system serviceable, acceptable inoperative.

Cont'd. ...

ELECTRICAL Cont'd

21. Passenger call system	Not essential.
22. Gear audible warning	Acceptable inoperative.
23. Stall protection	One warning and one stall recognition sub-system acceptable inoperative.
24. Floor Proximity Emergency Lighting	Whole or part of the system acceptable inoperative for return to LHR. Ex LHR Aisle Lights Individual aisle lights may be unserviceable provided that the aisle lights immediately fore and aft of the failed unit are serviceable. In addition the first and last aisle light in every aisle must be serviceable. Exit Identifier Exit identifier strobe tubes may be unserviceable. This is the only permitted unserviceability of Exit Identifiers which otherwise must be operative at each useable exit.

FIRE PROTECTION

1. Toilet Smoke Detection System	All or part of the system may be inoperative until next night stop at the aircrafts normal operating base. In all cases the Maintenance and Flight Crew Procedures below must be applied. Maintenance Procedure (a) Trip and gag the Flight Deck "Toilet Smoke" circuit breaker to isolate the system if false warnings are being given. (b) Placard the appropriate channel on the C/M panel "INOP". (c) Record as an ADD.

FIRE PROTECTION Cont'd.

	Item	Flight Crew Procedure
		Ensure Cabin Crew are briefed to maintain periodic checks, e.g. every 30 minutes, on the affected toilet compartment.
	FUEL SYSTEM	
	1. Booster pumps	One pump in each tank acceptable inoperative. If it is a rear booster pump unserviceable, (a) The contents of the affected tank before take-off shall not be less than 2500kg. Normal Requirements for symmetrical loading between tanks must be observed. (b) Reserve Fuel must be increased to 2000kg. (See Abnormal Management).
P	2. Transfer pumps	If centre tank empty, acceptable inoperative.
P	3. Transfer valves	If centre tank empty, acceptable inoperative
	4. Transfer LP warning	Not essential.
P	5. Wing tank contents gauge	One wing system acceptable inoperative for a maximum of 6 sectors, but not departing LHR. Before each flight, the quantity of fuel in a tank associated with an unserviceable quantity gauge must be determined by use of the fuel level indicators. This check must be witnessed by the Captain or Co-pilot. Both flowmeters must be serviceable.

P	6.	Centre tank contents gauge	If both wing tank contents gauges serviceable, acceptable inoperative. Before each flight, the quantity of fuel in a tank (even if the quantity required is zero) associated with an unserviceable quantity gauge must be determined by use of the fuel level indicators. This check must be witnessed by the Captain or Co-pilot. Both fuel totalisers must be serviceable.
	7.	Engine backing pump	Not essential providing engine backed by two booster pumps for take-off.
	8.	Fuel totalisers	If fuel gauges and flowmeters serviceable, one acceptable inoperative.
	9.	Fuel flowmeters	Providing associated Thrust (P7) Gauge serviceable, either one acceptable inoperative.
	10.	Wing tank pressure refuelling facility	If centre tank empty, acceptable inoperative.
	11.	Centre tank pressure refuelling facility.	Not essential.
	12.	Pressure refuelling blanking cap	Not essential.
P	13.	Fuel tanks	Centre not essential
	14.	Engine low pressure warning	Providing booster pump warnings serviceable, acceptable inoperative.
	15.	Magnetic indicators	Providing appropriate valve/cock proved serviceable if required, acceptable inoperative.
	16.	Fuelling load limit control	Acceptable inoperative.
	17.	Booster pump LP warning	One only acceptable inoperative.
P	18.	Cross Feed valve	Providing locked in CLOSED position, acceptable inoperative.

HYDRAULICS

P	1.	Engine driven pumps	Provided all generators, auxiliary pumps and DC pump serviceable, No. 1 or 2 EDP acceptable inoperative. Drive to be removed from the inoperative EDP.
	2.	System pressure indication	Providing system failure warning serviceable, either one acceptable inoperative.
	3.	Reservoir contents indication	Providing associated system pressure gauge serviceable, either one acceptable inoperative.
	4.	Reservoir air pressure warning facility	Providing associated overheat warning available, not essential.
	5.	Ground servicing reservoir air pressure gauge	Not essential.
	6.	Main accumulator air pressure gauge	Not essential.
	7.	Brake accumulator air pressure servicing gauge	Not essential.
	8.	Standby steering accumulator air pressure gauge	Not essential.
	9.	Pressure failure warning	Providing associated pressure indicator serviceable, one only acceptable inoperative.
	10.	Overheat warning	Acceptable inoperative for one system only. Once per day check system not overheating by checking reservoir temperatures immediately after engine shutdown.
	11.	EDP off-load facility	Either one acceptable inoperative.

INSTRUMENTS (contd)

General

28.	OAT gauge	Not essential
29.	Clock	Not essential
30.	Elapsed time clock	Only one essential
31.	Flight recorder	(a) Mandatory Recording. Providing Cockpit Voice Recorder operative, acceptable inoperative for 6 consecutive flights or 48 hours elapsed time whichever is the lesser period (b) Quick Access Recorder - not essential
32.	Cockpit Voice Recorder	Providing Flight Data Recorder operative for mandatory recording, acceptable inoperative for 6 consecutive flights or 48 hours elapsed time whichever is the lesser period.
33.	High Speed Warning	Providing both Machmeters serviceable - not essential
34.	Altitude Warning Device	Not essential

POWER PLANT

	1.	Igniter 'ON' lamp	Not essential.
	2.	LP shaft rotation lamp	Not essential. Ensure LP assembly free before each start.
	3.	LP rpm indicator	Providing HP rpm and P7 gauge serviceable, not essential.
	4.	HP rpm indicator	Providing LP rpm and P7 gauge serviceable, not essential.
	5.	Top temperature control	Not essential.
	6.	Oil pressure gauge	Providing low pressure warning device serviceable, not essential.
	7.	Oil low pressure warning	Providing oil pressure gauge serviceable, not essential.
P	8.	Thrust reversers	Either one or both acceptable inoperative. Defective unit to be immobilized. Refer Flight Handling Special Procedures.
	9.	Thrust reverser 'UNLOCKED' warning	Providing associated system proved serviceable, one only acceptable inoperative.
	10.	Fuel temperature gauge	Not essential.
	11.	Oil temperature gauge	Provided oil pressure gauge serviceable, not essential.
	12.	Engine vibration indication	Not essential.
P	13.	Thrust (P7) gauge	Provided all other engine instruments serviceable, one only acceptable inoperative for flight to first station at which rectification can normally take place. Refer Abnormal Management ENGINES.

UPHOLSTERY AND EQUIPMENT

P	1.	Lifejackets	For flights over water, one essential for each person carried. See also item 2.
	2.	Child life jackets	Not essential.
	3.	Seat belts	One essential for each person carried.
	4.	Seat belt notice	Providing cabin staff carried, not essential.
	5.	Chair adjustment	Providing chair locked in upright position, acceptable inoperative.
P	6.	Oxygen	(a) Crew Up to 10,000 ft minimum acceptable contents - 3/8. Above 10,000 ft normal contents essential. (b) Cabin Crew Above 10,000 ft portable equipment essential for each non-supernumary crew member. (c) Passengers Essential for 10% of carried passengers from 10,000 ft to 30,000 ft and for 15% above 30,000 ft. NOTES: (i) 3/8 contents ensures 15 mins smoke protection for operating crew. (ii) Gauge is linear. Interpolation between 3/4 full red mark and zero is acceptable.
	7.	Megaphone	One is essential, situated in the forward stowage.
	8.	Water system drain line and outlet heaters	Acceptable inoperative (some restriction may result).
	9.	Asbestos Gloves	Not essential.
	10.	Smoke hoods	Not essential.
	11.	First Aid kit	Used items acceptable missing except departing base.
	12.	Eyewash pack	Not essential.
	13.	Passenger Restraint Pack	May be inoperative or missing until next night stop at LHR.

RADIO

	1.	CCE	(a) Auxiliary ground crew jack boxes not essential. (b) Two pilot stations essential.
	2.	Cabin Address System	Not essential provided that there are two serviceable megaphones available - one in flight deck and one at fwd. cabin crew position.
P	3.	Weather radar	(a) Weather facility essential when cumulo-nimbus or other hazardous conditions are expected, unless such hazards can be seen and avoided in daylight. (b) Mapping facility - not essential. (c) Stabilisation facility - not essential. (d) Indicator unit - RH acceptable inoperative.
P	4.	Radio altimeter	Essential for Cat 2 and 3A.
P	5.	Comms/Nav Aid Equipment	See page 21
P	6.	Transponder	(a) Single system operation see pages 22, 23 and 24. (b) Dual system - either system acceptable inoperative.
	7.	Ground Proximity Warning System	Must be serviceable on departure unless the defect cannot reasonably be rectified. A defect may not be carried forward from the previous day if the aircraft has nightstopped in LHR or TXL.
	8.	Radio cooling fans	See Air System section.

MINIMUM NAV/COMMS COMPLEMENT P

Aircraft normally should have all NAV/COMMS equipment serviceable at departure. In the event of any NAV/COMMS equipment being unserviceable an aircraft may proceed at the Captain's discretion provided it has serviceable NAV/COMMS to the scale listed below. Only in exceptional circumstances may an aircraft leave a repair base (LHR or TXL) with a VHF COMMS set unserviceable.

NOTE 1: VHF 1 and ADF 1 must be operative EXCEPT in V.M.C.

NOTE 2: For flights back to base ONLY with less than minimum NAV/COMMS complement listed below see last paragraph on this page.

Minimum NAV/COMMS Complement

1 VHF (see Note 1)
2 VOR
1 ADF (see Note 1)
1 MKR
1 DME
1 ILS

Where not more than one item of NAV/COMMS equipment listed above is unserviceable when the aircraft is about to begin a flight, the aircraft may nevertheless take-off on that flight if:-

(i) it is not reasonably practicable for the repair or replacement of that item to be carried out before the beginning of the flight: and

(ii) the aircraft has not made more than one flight since the item was last serviceable: and

(iii) the commander of the aircraft has satisfied himself that, taking into account the latest information available as to the route and aerodrome to be used (including any planned diversion) and the weather conditions likely to be encountered, the flight can be made safely and in accordance with any relevant requirements of air traffic control.

Transponder Mode A and C Requirements

Countries	Mode A	Mode C	Remarks
UK	FL245 and above (ALL UK Airspace)	FL245 and above (ALL UK Airspace)	
UK	All Flight Levels (All UK Controlled Airspace)	FL100 and above (All UK Controlled Airspace)	
Netherlands	All Flight Levels (Controlled Airspace)	All Flight Levels (Controlled Airspace)	Amsterdam FIR/UIR
Belgium	All Flight Levels	All Flight Levels	Controlled Airspace
France	All Flight Levels (Controlled Airspace)	All Flight Levels (Controlled Airspace)	Paris, Lyon, Marseille, Nice, Bordeaux, Toulouse.
Eire	FL250 and above	FL250 and above	Shannon
Denmark	All Flight Levels	All Flight Levels	Copenhagen FIR and TMA
Sweden	All Flight Levels	All Flight Levels (Controlled Airspace)	Upper CTA within FIRs. South of 61° 00'N.
Switzerland	All Flight Levels (Controlled Airspace)	All Flight Levels (Controlled Airspace)	

Countries	Mode A	Mode C	Remarks
Austria	All Flight Levels	All Flight Levels	Wien FIR
Czechoslovakia	FL100 and above	FL100 and above	Prague and Bratislava Control Areas
Israel	Controlled Airspace	Controlled Airspace	Tel Aviv FIR
Italy	All Flight Levels	All Flight Levels	Rome FIR and Italy UIR Central Sector
Norway	All Flight Levels	All Flight Levels	Oslo FIR/UIR
Poland	All Flight Levels	All Flight Levels	Warsaw FIR
Spain	FL200 and above	FL200 and above	Madrid FIR/UIR
"	FL200 and above	FL200 and above	Barcelona FIR/UIR
"	All Flight Levels	All Flight Levels	Madrid, Barcelona and Palma de Mallorca TMAs
Iceland	All Flight Levels	All Flight Levels	Reykjavik Area Control and Centre
Federal German Republic	All Flight Levels (Controlled Airspace)	All Flight Levels (Controlled Airspace)	

RADIO Special Procedures

SSR Transponder Failure

The following countries permit aircraft with a defective transponder to be operated to the next scheduled stop at which the transponder can be repaired provided that, before departure, the pilot:

1. Informs ATC of the defect as soon as possible.
2. Refiles or amends the flight plan inserting in item 10 under SSR the letter N in the case of a complete failure and the letter H in the case of a mode C height readout failure.

Belgium
Czechoslovkia
Federal Republic of Germany
France
Ireland
Luxembourg
Netherlands
Spain
Sweden
Switzerland
United Kingdom

Areas	Mode A	Mode C	Remarks
3.	No Requirement	No Requirement	
4.			
Austria	All Flight Levels	All Flight Levels	Wien FIR
Czecho-slovakia	FL100 and above	FL100 and above	Prague and Bratislava Control Areas
Israel	Controlled Airspace	Controlled Airspace	Tel Aviv FIR
Italy	All Flight Levels	All Flight Levels	Rome FIR and Italy UIR Central Sector
Norway	All Flight Levels	All Flight Levels	Oslo FIR/UIR
Poland	All Flight Levels	All Flight Levels	Warsaw FIR
Spain	FL200 and above	FL200 and above	Madrid FIR/UIR
"	FL200 and above	FL200 and above	Barcelona FIR/UIR
"	All Flight Levels	All Flight Levels	Madrid, Barcelona and Palma de Mallorca TMAs
Switzerland	See Area 2	See Area 2	
5.			
Iceland	All Flight Levels	All Flight Levels	Reykjavik Area Control Centre
6.			
Federal German Republic	All Flight Levels (Controlled Airspace)	All Flight Levels (Controlled Airspace)	

RADIO Special Procedures

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Belgium
Czechoslovakia
Federal Republic of Germany
France
Ireland
Luxembourg
Netherlands
Spain
Sweden
Switzerland
United Kingdom

LOADING INSTRUCTIONS

SUPER 1-11

CONTENTS

PART 1

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LOADING

CONTENTS

NOTE

This chapter contains pages common to parts of the Load and Balance Manual for SUPER 1-11 aircraft, ATP 1293, to which reference should be made if further information on Loading is required. To facilitate cross-reference each item in this contents list is preceded by the chapter and subject references of the Load and Balance Manual. Also, each page carries the page number and issue date of the Load and Balance Manual page.

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SUMMARY OF A/C WEIGHT & FUEL MANAGEMENT LIMITATIONS

1. MAXIMUM AUTHORISED WEIGHTS (KG)

Taxi	Take-Off	Landing	Zero Fuel
41950	41950*	39000	35381

* Reduced to 41730 kg for operational use to allow for 220 kg for start up and taxi fuel.

2. FUEL

A. Minimum Fuel for Take-Off
2200 kg (2778 litres).

B. Maximum Fuel
11160 kg (14092 litres).

C. Fuel Loading
Fuel must be loaded in accordance with the Fuel Loading Tables (ATP 886/ ATP 516), which assume a fuel density of 0.7919 kg/litre (mean specific gravity 0.7936).

D. Start Up and Taxi Allowance
220 kg.

E. Fuel Usage
Refer to Pilots Check Lists and Drills (ATP 870).

F. Fuel Asymmetry
Refer to Flight Management (ATP 871).

SPECIAL CASES

1. LOADING FOR AIRWORTHINESS, MAINTENANCE TEST AND TRAINING FLIGHTS

LOADING FOR AIRWORTHINESS, MAINTENANCE TEST AND TRAINING FLIGHTS

Flight Classification	Aircraft Condition	Crew and Observers	TO Fuel kg	Ballast (a)(b) kg	Remarks
Airworthiness & Maintenance Test Flights involving stalling	99 Seater fully equipped for service. Stall Test Instrumentation fitted to Mod 27A108 (6 kg).	3 or 4 (3 in cockpit, 4th in Row 1).	11,160 (Full tanks)	Cpt 1 = 350 (In centre of compartment)	1. TO Weight of 35,889 kg (3 crew) for a Weight Schedule Basic Weight of 24,004 kg. 2. TO CG approximately 0.32 SMC (3 crew). 3. 4th person (in Row 1) will move CG forward by 0.006 SMC.
Maintenance Air Test (not to be used for stall checks).	99 Seater fully equipped for service.	2 or 3 in cockpit.	As required up to the maximum of 11,160.	Cpt 1 = 500	1. TO Weight to be calculated. 2. TO CG approximately 0.32 SMC (2 crew).
Training Flights	As above	3 to 5 (3 in cockpit, 2 in Row 1).	11,160 (Full tanks)	Cpt 1 = 1,900 Cpt 2 = 1,000 Cpt 3 = 1,025 Total = 3,925	1. TO Weight to be calculated. 2. TO CG approximately 0.21 SMC.
Positioning Flights Case 1 and Initial Line Checks	As Above	3 to 5 (3 in cockpit 2 on fwd cabin crew seat)	As required up to the maximum of 11,160.	Nil.	1. Only valid for a/c having a Basic Index not greater than 86.9. 2. Minimum crew allowable - 3 in cockpit. 3. Fuel at landing must not be less than 4000 kg. 4. TO Weight to be calculated. 5. TO CG approximately 0.36 SMC.

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Flight Classification	Aircraft Condition	Crew and Observers	TO Fuel kg	Ballast (a)(b) kg	Remarks
Positioning Flights Case 2	As above	2 in cockpit	As required up to the maximum of 11,160	Cpt 1 = 400	1. Only valid for a/c having a Basic Index not greater than 86.9. 2. TO Weight to be calculated. 3. TO CG approximately 0.34 SMC.

NOTES:

(a) If spares are carried then reduce ballast in Compartment(s) affected to achieve a similar weight to that specified.

(b) The ballast (and spares) must be adequately lashed to prevent movement in flight.

(c) Any other personnel carried to sit in Rows 12-15 (Rows 1-4 on Positioning Flights and Initial Line Checks).

Catering trolleys (11 fwd - 144 kg), carried on all flights are not included in the Basic Weight. If catering is carried on Positioning Flights the quoted weight will include trolleys.

AIRCRAFT WEIGHT & INDEX DATA

1. AIRCRAFT VERSIONS

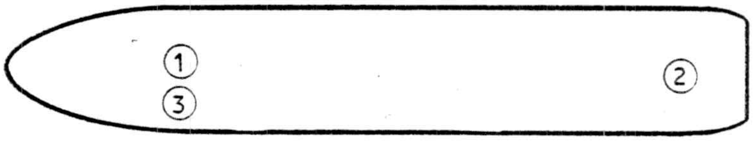
Version Code	Configuration
B15A	99 Seater (99Y)
B5SA	99 Seater (99Y) 'Shuttle'

2. BASIC WEIGHT & BASIC INDEX

The Weight Schedule Extract displayed on the flight deck, shows the current Basic Weight and Basic Index for that aircraft.

3. CREW WEIGHTS & INDICES

The index effect assumes technical crew seated on the flight deck and cabin crew seated in the following order.



For any cabin crew combination not included above refer to table in Chapter 7.

The table below assumes crew bags stowed as follows:

Flight Deck crew - On Flight Deck.

Cabin crew - At crew seat positions.

Flight Deck Crew		Cabin Crew		
		0	2	3
2	KG	170	340	425
	IU	-0.9	-1.1	-1.4
3	KG	255	425	510
	IU	-1.4	-1.5	-1.9

NOTES: A standard crew weight of 75 kg + 10 kg of baggage is assumed for all crew.

On payload restricted sectors crew weights may be reduced by 10 kg for each female crew member.

4. CATERING WEIGHTS & INDICES

CATERING LOADS B15A

CODE	LOAD IN FWD. GALLEYS (KG)	INDEX EFFECT
A	660	-3.0
B	575	-2.6
C	490	-2.2
D	410	-1.8
E	310	-1.5

CATERING LOADS B5SA

CODE	LOAD IN FWD. GALLEYS (KG)	INDEX EFFECT
A	225	-1.0

CATERING LOADS - NON SCHEDULED SERVICES (All Versions)

e.g. Training Flights, Charter Flights.

Use Additions and Deductions Index Table in Chapter 7.

5. DRY OPERATING WEIGHT & INDEX

The Dry Operating Weight/Index is the total of the aircraft Basic Weight/Index, the crew weight/index, the catering weight/index and any adjustment required to the Basic Weight/Index.

6. WEIGHT OF EQUIPMENT OCCASIONALLY STOWED IN HOLDS (Allowed for as EIC)

Stretcher, mattress and blankets in canvas bag	25 kg
Stretcher support frame, 2 trestles and curtains in canvas bag	36 kg
Double seat + lifejackets	24 kg

7. WEIGHT OF EQUIPMENT OCCASIONALLY CARRIED IN CABIN (Allowed for as EIC)

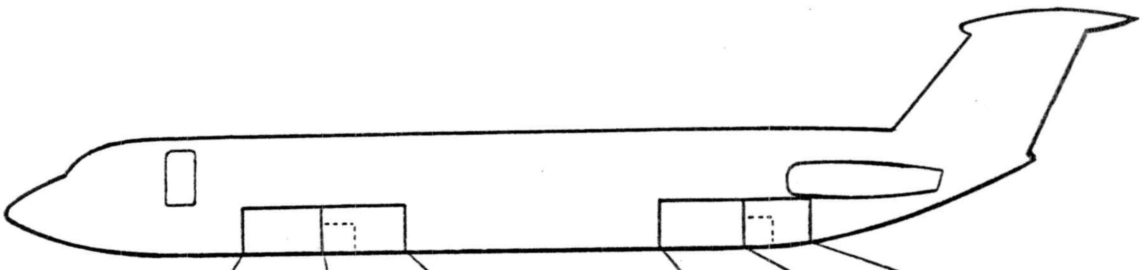
One trestle-mounted stretcher unit (complete)	61 kg
One floor-mounted (emergency) stretcher & curtain	20 kg
One Cargo 'Pak' or 'Uplift' bag	7 kg

8. ADJUSTMENTS TO BASIC WEIGHT & BASIC INDEX

Emergency Floor-Mounted Stretcher

Seats removed from Rows 18, 19 and 20 left.
Basic Weight minus 72 kg.
Basic Index minus 0.2 IU.

MAXIMUM LOADS IN COMPARTMENTS



1	2	COMPARTMENT NUMBER	3	4
1990*	1980*	MAX COMPARTMENT LOAD (kg)	1860*	860*
732 68		MAX FLOOR LOADING kg/sq m kg/sq ft	732 68	
5.66 200	5.24 185	USABLE VOLUME cu m cu ft	5.04 178	2.32 82

* The maximum loads apply with any catering load and any number of passengers.

PACKAGE ACCEPTANCE DATA

1. BULK LOADING

A. MAXIMUM PACKAGE SIZES IN COMPARTMENTS 1 AND 2

From the intersection of the appropriate height and width columns read off the maximum length. Where the exact height/width is not shown use the nearest height/width greater than the one being considered.

cm		WIDTH								
		Up to 10	20	30	41	51	61	71	81	86
HEIGHT	Up to 10	356	356	356	356	330	279	267	241	229
	20	356	356	356	356	305	279	267	229	224
	30	356	356	356	356	279	267	254	229	218
	41	356	356	356	305	279	254	229	216	216
	51	330	330	305	279	254	241	216	203	191
	61	305	305	279	254	241	229	191	191	165
	71	279	254	254	229	203	203	165	152	152
	81	254*	228*	203*	203*	178*	165*	140*	140*	122*
	86	127*	127*	127*	127*	122*	122*	-	-	-

Inches		WIDTH								
		Up to 4	8	12	16	20	24	28	32	34
HEIGHT	Up to 4	140	140	140	140	130	110	105	95	90
	8	140	140	140	140	120	110	105	90	88
	12	140	140	140	140	110	105	100	90	86
	16	140	140	140	120	110	100	90	85	85
	20	130	130	120	110	100	95	85	80	75
	24	120	120	110	100	95	90	75	75	65
	28	110	100	100	90	80	80	65	60	60
	32	100*	90*	80*	80*	70*	65*	55*	55*	48*
	34	50*	50*	50*	50*	48*	48*	-	-	-

* Only valid if package is light enough to be manhandled into the compartments.

B. MAXIMUM PACKAGE SIZES IN COMPARTMENTS 3 AND 4

From the intersection of the appropriate height and width columns read off the maximum length. Where the exact height/width is not shown use the nearest height/width greater than the one being considered.

cm		WIDTH								
		Up to 10	20	30	41	51	61	71	81	86
HEIGHT	Up to 10	279	279	279	279	279	274	254	203	203
	20	279	279	279	279	279	267	241	203	203
	30	279	279	279	279	279	254	229	203	191
	41	279	267	267	267	254	241	216	203	191
	51	267	254	254	254	241	229	203	178	160
	61	254	254	241	241	224	216	185	137	137

Inches		WIDTH								
		Up to 4	8	12	16	20	24	28	32	34
HEIGHT	Up to 4	110	110	110	110	110	108	100	80	80
	8	110	110	110	110	110	105	95	80	80
	12	110	110	110	110	110	100	90	80	75
	16	110	105	105	105	100	95	85	80	75
	20	105	100	100	100	95	90	80	70	63
	24	100	100	95	95	88	85	73	54	54

CARGO RESTRAINT

1. CLASSIFICATION OF LOAD

CLASS I	An item weighing 250 kg or more
CLASS II	An item weighing between 75 kg or 250 kg
CLASS III	An item weighing 75 kg or less

2. BULK LOADING

A. COMPARTMENT NETS

These are to be erected whenever there is load in the compartment and around a doorway when there is load in the doorway area.

A net immediately forward of load must not restrain more than 1360 kg. Any load in excess of this amount must be individually restrained by means of lashing.

The movable transverse nets in Compartment 2 and Compartment 3 should be positioned as close as possible to the load except when the compartments are full in which case it should be attached at position B (see 2.D. Positions of Doors, Nets and Lashing Rings).

B. ITEMS REQUIRING INDIVIDUAL LASHING

The following items require individual lashing:

(1) Class I

(2) Class II unless the 'restraint space'* is at least 75% volumetrically full.

(3) Items of any kind which due to their nature could constitute a hazard if not secured.

* 'restraint space' is the space between a bulkhead and a secured net or between two secured nets.

C. TIE DOWN REQUIREMENTS

(1) Minimum Number of Restraints

Weight of Item kg	Minimum Number of Ropes or Straps required to restrain movement			
	Fore/Aft	Sideways	Upwards	Remarks
	USING FLOOR RINGS			
Up to 300	2	2	2	2 ropes or straps attached to sidewall = 1 rope or strap attached to floor.
301 - 500	2	2	4	

NOTE: Ropes or straps used in fore/aft and sideways can also provide upward restraint.

(2) Approved Tie Down Materials

(a) 8 mm dia (1" circ) Polypropylene Rope (breaking strength 950 kg or more).

(b) 12 mm dia (1½" circ) Sisal Rope (breaking strength 950 kg or more).

(c) 25 mm (1") Tie Down straps (breaking strength 800 kg or more).

(d) Rope having a breaking strength of 950 kg or more.

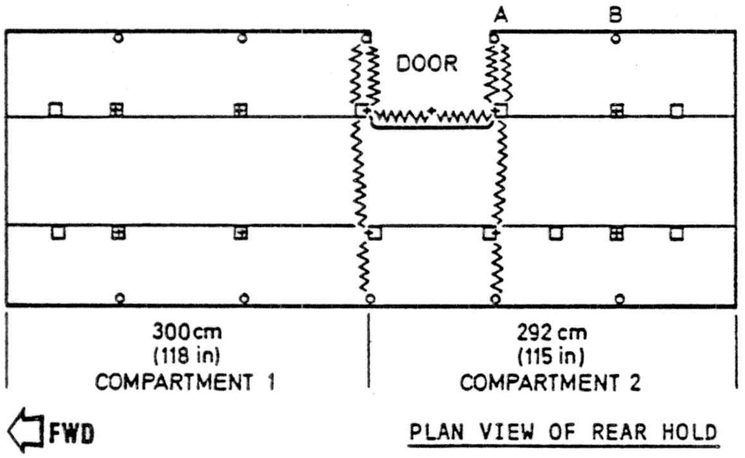
(3) Tie Down Fittings.

(a) Not more than one rope or strap to be used in each ring fitted in the compartments.

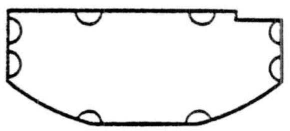
(b) A ring used to support a net is not to be used for restraint of individual items.

D. POSITIONS OF DOORS, NETS AND LASHING RINGS.

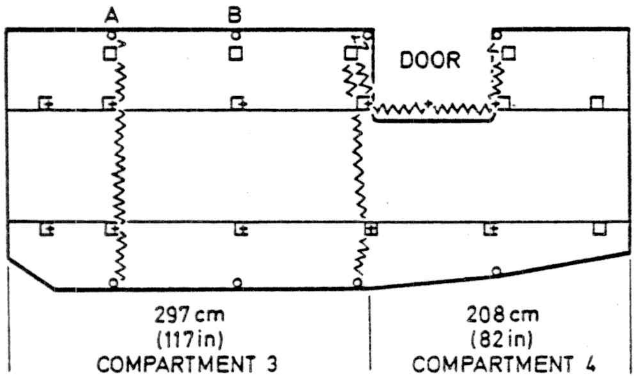
PLAN VIEW OF FRONT HOLD



TYPICAL SECTION



PLAN VIEW OF REAR HOLD



+ Ring in Roof
□ Ring in Floor
∘ Ring on Sidewall
⋀⋀⋀ Nylon Nets (The nets shown at position A can also be used at B)
O Ring on Sidewall

Any Ring used for attachment of Nets must not also be used for Rope Lashing.

LOAD SPREADING

1. Tables 1 and 2 on pages 03-05-02 and 03-05-03 are to be used to calculate load spreading requirements for single packages to be stowed in the underfloor Compartments.

   (i) Use Table 1:-
   a) To calculate whether Spreaders are required
   and b) If Spreaders are required, to calculate the minimum length necessary.

   (ii) THEN if Spreaders are required:-
   Use Table 2 to check that the length of Spreaders from Table 1 is not too long to be effective.

2. Terms used:

   EFFECTIVE PACKAGE LENGTH

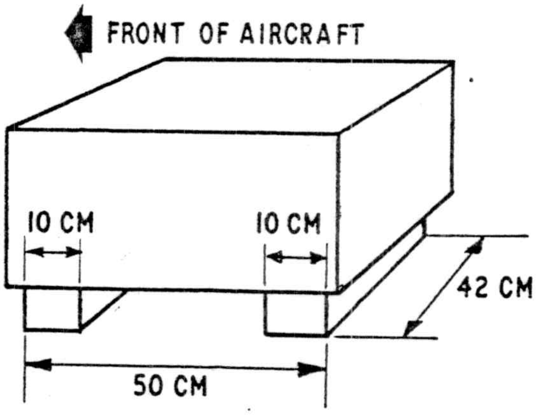
   e.g. = 50 cm

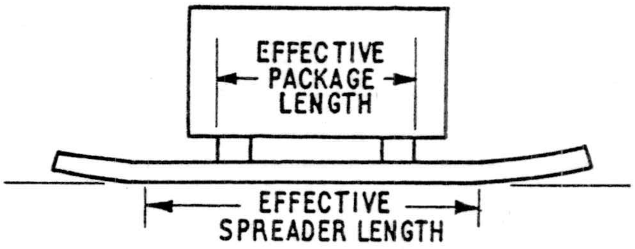
   CONTACT WIDTH

   e.g. = 42 cm

   CONTACT LENGTH

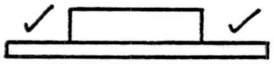
   e.g. = 20 cm (2 x 10) cm

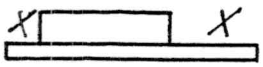




3. Spreader Limitations:

   (a) Spreader Overhang must be equal at both ends.





   (b) Spreader must be in contact with the package.
   (c) Spreader length required must be a single piece of wood.
   (d) Spreader when in contact with the floor must be placed with its ends towards the front and rear of the aircraft.
   (e) Spreader weights must be added to the weight of the package being spread when using Table 1.
   (f) Spreader must have a minimum thickness of 4 cm (1½ inches).

4. General Limitations:

   (a) Do not load Class 1 packages on top of any other package.
   (b) If any package has been loaded on to Spreader do not load other packages on top of the original package or on top of the Spreader overhang.

TABLE 1

(a) TO CALCULATE IF SPREADERS ARE REQUIRED:

The intersection of the 'CONTACT LENGTH' and 'CONTACT WIDTH' of the package shows the MAXIMUM permitted weight of the package without using the Spreaders.

Enter the table using sizes equal to or less than the actual contact length and width - e.g. for 67 cm use 60 cm.

IF THE PACKAGE EXCEEDS THIS WEIGHT - SPREADERS ARE REQUIRED.

(b) TO CALCULATE THE MINIMUM LENGTH OF SPREADERS REQUIRED:

(i) Find out the width of spreaders available.
(ii) Decide how many spreaders of this width will be used for the package.
(iii) The 'CONTACT WIDTH' of the spreaders will be the width of a spreader multiplied by the number used -
e.g. 2 x 20 cm spreaders = CONTACT WIDTH of 40 cm.
(iv) Enter the left hand column at this contact width and select a weight on that line big enough to include the weight of packages and spreader.
(v) The minimum length of spreader to be used will be the figure at the top of this column.
(vi) It can be seen from the Table that various combinations of 'CONTACT LENGTH' and 'CONTACT WIDTH' can be used for any particular package.

CONTACT LENGTH 10 - 150 cm (4 - 60 in)

		IN	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
	IN	CM	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	
CONTACT WIDTH	4	10	7	15	22	29	37	44	51	59	66	73	81	88	95	102	110	WEIGHT (KG)
	8	20	15	29	44	59	73	88	102	117	132	146	161	176	190	205	220	
	12	30	22	44	66	88	110	132	154	176	198	220	242	264	285	307	329	
	16	40	29	59	88	117	146	176	205	234	264	293	322	351	381	410	439	
	20	50	37	73	110	146	183	220	256	293	329	366	403	439	476	512	549	
	24	60	44	88	132	176	220	264	307	351	395	439	483	527	571	615	659	
	28	70	51	102	154	205	256	307	359	410	461	512	564	615	666	717	769	
	32	80	59	117	176	234	293	351	410	468	527	586	644	703	761	820	878	

CONTACT LENGTH 160 - 300 cm (61 - 120 in)

		IN	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	
	IN	CM	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	
CONTACT WIDTH	4	10	117	124	132	139	146	154	161	168	176	183	190	198	205	212	220	WEIGHT (KG)
	8	20	231	249	264	278	293	307	322	337	351	366	381	395	410	425	439	
	12	30	351	373	395	417	439	461	483	505	527	549	571	593	615	637	659	
	16	40	468	498	527	556	586	615	644	673	703	732	761	791	820	849	878	
	20	50	586	622	659	695	732	769	805	842	878	915	952	988				
	24	60	703	747	791	834	878	922	966									
	28	70	820	871	922	974												
	32	80	937	996														

CONTACT LENGTH 310 - 450 cm (124 - 180 in)

		IN	124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	
	IN	CM	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	
CONTACT WIDTH	4	10	227	234	242	249	256	261	271	278	285	293	300	307	315	322	329	WEIGHT (KG)
	8	20	454	468	483	498	512	527	542	556	571	586	600	615	630	644	659	
	12	30	681	703	725	747	769	791	813	834	856	878	900	922	944	966	988	
	16	40	908	937	966	996												

TABLE 2

TO CALCULATE THE EFFECTIVE LENGTH OF SPREADERS REQUIRED:

(i) Enter the top line of the table at a length exactly equal to or less than the 'EFFECTIVE PACKAGE LENGTH'.
(ii) Read the 'EFFECTIVE SPREADER LENGTH' directly underneath.
(iii) Check that the minimum length of Spreader required (from Table 1) is not greater than this figure.

NOTE: Longer Spreaders may be used, but they will only be effective over the length obtained from Table 2.

EFFECTIVE LENGTH (cm)

PACKAGE	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
SPREADER	17	35	52	70	87	105	122	140	157	175	192	210	227	245	262	280	297	315

PACKAGE	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
SPREADER	332	350	367	385	402	420	437	455	472	490	507	525	542	560	571	595	612

EFFECTIVE LENGTH (in)

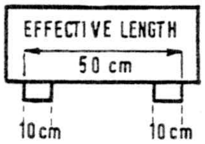
PACKAGE	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
SPREADER	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126

PACKAGE	76	80	84	88	92	96	100	104	108	112	116	120	124	128	132	136	140
SPREADER	133	140	147	154	161	168	175	182	189	196	203	210	217	224	231	238	245

EXAMPLES OF USE OF TABLES 1 and 2

(i) Box 73 cm long 42 cm wide - weight 180 kg.
(Entire base of box in contact with floor).
Enter Table 1 at contact length 70 cm and contact width 40 cm.
Maximum Permitted weight 205 kg.
As the box weighs less than this, spreaders are NOT required.

(ii) Box 73 cm long 42 cm wide - weight 180 kg
(Box has two full width battens on base).

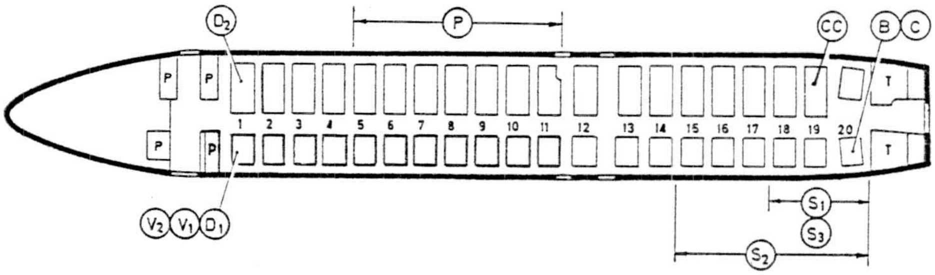


Contact length 20 cm. Contact width 42 cm.
Enter Table 1 at contact length 20 cm and contact width 40 cm.
Maximum Permitted Weight 59 kg.
Spreaders are required.
If 20 cm wide spreader available. Using 2 - contact width is 40 cm.
Enter Table at contact width 40 cm.
205 kg is adequate for box and spreaders.
Minimum length of each spreader is 70 cm.
Check from Table 2 that spreader selected is not too long.
For an effective package length of 50 cm a spreader is effective up to 87 cm long.

The spreaders selected from Table 1 are therefore suitable.

RESTRAINT OF CABIN LOADED ITEMS

B15A
AND
B5SA



Article	Ref	Stowing Details	Limitations
Vaulting Poles	Ⓟ	Place pole(s) on floor beneath seats 5D to 11D inclusive. Secure pole(s) to the seat legs of at least 4 seat units.	INTERNAL GERMAN SERVICES AND CHARTER FLIGHTS ONLY Not more than 3 poles to be carried.
Double Bass	Ⓑ	Move Row 19 left forward so that it butts against Row 18 left. Raise centre armrest in Row 20. Secure bass to seat rail fittings.	Size (183 x 76 x 51) cm (72 x 30 x 20) in Do not exceed seat back height. Carried at owner's risk
One Cello	Ⓒ	Lift base of seat 20A Stand cello on floor at seat 20A Lash to seat	Size (122 x 48 x 30) cm (48 x 19 x 12) in Do not interfere with recline in Row 19. Carried at owner's risk
Two Cellos	(CC)	Raise centre armrests Place cellos flat on seat. Lash to seat.	Length 140 cm (55 in) Carried at owner's risk.

/Cont'd. ...

RESTRAINT OF CABIN LOADED ITEMS

<table>
<tr><th>Article</th><th>Ref</th><th>Stowing Details</th><th colspan="2">Limitations</th></tr>
<tr><td>Valuable/ Delicate Baggage</td><td>V_1</td><td rowspan="2">Use seat A and, if necessary, C.
Raise armrest between Seats A and C if two seats required.
Protect seat.
Place article against seat back and secure to seat.
Ensure no interference with gangway or passengers.</td><td colspan="2">Max Weight 35 kg<table><tr><th></th><th colspan="2">One Seat</th><th colspan="2">Two Seats</th></tr><tr><td></td><td>cm</td><td>in</td><td>cm</td><td>in</td></tr><tr><td>Length</td><td>51</td><td>20</td><td>51</td><td>20</td></tr><tr><td>Width</td><td>41</td><td>16</td><td>86</td><td>34</td></tr><tr><td>Height*</td><td>30</td><td>12</td><td>30</td><td>12</td></tr></table>* Can be increased to 51 cm (20 in) if item is of resilient nature.
Carried at owner's risk.</td></tr>
<tr><td>Valuable Pictures</td><td>V_2</td><td colspan="2">Max Weight 35 kg<table><tr><th></th><th colspan="2">One Seat</th><th colspan="2">Two Seats</th></tr><tr><td></td><td>cm</td><td>in</td><td>cm</td><td>in</td></tr><tr><td>Length</td><td>43</td><td>17</td><td>91</td><td>36</td></tr><tr><td>Height</td><td>64</td><td>25</td><td>64</td><td>25</td></tr></table>Carried at owner's risk</td></tr>
<tr><td rowspan="2">Queen's Messenger Mail</td><td>D_1</td><td>Use Seat 1A.
Use special Cargo 'Pak' or authorised alternative - see Instruction 03-07</td><td>One seat place</td><td rowspan="2">Max 78 kg per seat place
Do not exceed seat back height</td></tr>
<tr><td>D_2</td><td>Use Seat 1E and 1F
Use special Cargo 'Pak' or authorised alternative - see Instruction 03-07</td><td>Two seat places</td></tr>
<tr><td>Stretcher</td><td>S_1
S_2
S_3</td><td>Single Trestle Mounted
Double Trestle Mounted
Single Floor Mounted
See Instruction 03-08</td><td colspan="2"></td></tr>
</table>

STOWAGE OF QUEEN'S MESSENGER MAIL

1. FITMENT AND USE OF CARGO 'PAK'

(1) If two seat places are required raise outboard armrest of centre pair on triple seat.

(2) Place 'Pak' on seat, pass seat belts through loops at rear of 'Pak' and secure tightly.

(3) Remove the seat rail capping strips at foot of 'Pak' and engage the lashing rings at the bottom of the 'Pak' into the seat rails.

(4) Stretch the cord elastic around seat backs to support 'Pak' for loading. Open the flaps.

(5) After loading, close and secure the flaps and release the cord elastic.

2. ALTERNATIVE METHOD WHEN CARGO 'PAK' NOT AVAILABLE

(1) Obtain following equipment

a) Standard issue, cabin equipment blanket (2 per seat place).

b) Rope or webbing lashings.

(2) Position lashings to seat leg and seat belt as required for securing the load.

(3) Spread one blanket over seat cushion and drape over seat back.

(4) Load the Q.M. Mail onto seat cushion and onto floor in front of seat.

(5) Spread second blanket over top of load, and tuck in at front and sides.

(6) Secure load by lashings to prevent movement in flight.

CARRIAGE OF STRETCHER

1. RESPONSIBILITY FOR HANDLING

The responsibility for handling and securing the patient to the stretcher rests with a BA Medical Officer or other competent person delegated by him to supervise the loading.

2. SINGLE TRESTLE-MOUNTED STRETCHER

A stretcher case may be carried on the left side above the seats in Rows 18, 19 and 20. The procedure is as follows:-

(1) Free all the seat belts in Rows 18, 19 and 20 left so that they are not trapped by the back of the seats when folded.

(2) Fold the seat backs in Rows 18 and 19.

(3) Install one support trestle between Rows 19 and 20 as far aft as possible, and the other between Rows 18 and 19 as far forward as possible. Both trestles are to be positioned as far outboard as possible.

(4) Undo the clamps on the trestles.

(5) Position the support frame onto the trestles ensuring that the stencilled notice is on the outboard face and engage the outer upper tubes of the frame in the clamps but do not tighten yet.

(6) Reposition the frame, if necessary, so that the aft end tube just touches the upright seat backs of Row 20.

(7) Tighten all four clamps and check that the trestle feet are flat on the floor.

(8) Use the seat belts in Rows 19 and 20 to provide forward restraint by passing the ends over the crosstubes, forward of the seat belt anchorages, at the points marked 'Belts', and buckling in the normal manner.

(9) Use the seat belts in Row 18 to provide aft restraint by passing the ends over a crosstube, aft of the seat belt anchorages, at the points marked 'Belts', and buckling in the normal manner.

(10) Tighten the seat belts firstly in Rows 18 and 20, then in Row 19. Ensure the trestle feet are flat on the floor and that the trestle clamps are also tight.

(11) Recline the seat backs of Row 20 left.

(12) Fit the end curtains by means of the plug-in fittings. It may be necessary to pull the whole assembly inboard slightly to provide clearance between these bulkheads and the sidewall.

(13) Fit the inboard curtain assembly by means of the spigots and thumb screws. Unroll all curtains to check fitting.

(14) Roll up all curtains prior to loading. Check the whole assembly for security.

/Cont'd. ...

(15) Slacken off the four stretcher holding down straps and let them hang over the ends of the frame.

(16) Load stretcher through the ventral door and position on the support frame, patient's head forward, so that the stretcher feet are inside the transverse tubes nearest the ends.

(17) Loop the holding down straps over the stretcher handles and tighten all four straps. Check for security and adjust the curtains to suit, noting that the curtains have Velcro attachment strips.

The patient's lifejacket is stowed under the seats in Row 18, 19 or 20.

3. DOUBLE TRESTLE-MOUNTED STRETCHER

The second stretcher is placed above the seats in Rows 15, 16 and 17 left. The method of restraint and loading is as detailed for the single trestle-mounted stretcher case.

4. EMERGENCY FLOOR-MOUNTED STRETCHER

A stretcher case may be carried on the floor in the space obtained by the removal of the seat units from Rows 18, 19 and 20 left. The procedure is as follows:-

1. Remove Rows 18, 19 and 20 left.
2. Reposition the survival cots beneath Row 20 right.
3. Load stretcher through the ventral door and position, with patients head forward, so that the stretcher sits above the seat rails and the aft handles are 15 cm (6 in) from the toilet bulkhead.
4. Fit a lashing ring in the seat rail at each corner of the stretcher, approximately 15 cm (6 in) beyond the end of the stretcher canvas. Lash to these four rings, ensuring that lashings are taken from each handle and stretcher foot.
5. Place a lifejacket in hatrack above.
6. Erect privacy curtain using double sided tape to attach it to the hatrack.

LOADSHEET

1. GENERAL

A. ALL LOADSHEETS MUST CONFORM TO IATA RECOMMENDED PRACTICES.

B. BRITISH AIRWAYS USES THE FOLLOWING TYPE OF LOADSHEET:

Four Sector - manual (T978/A5991). Completed example 05-08-04
EDP Loadsheet - Departure Control System. Completed example 05-08-05.

2. DISTRIBUTION OF COPIES

To comply with Statutory and British Airways' requirements, copies of Loadsheets must be distributed as follows:

Original - To be retained on departure airport file with a copy of the Balance Chart (if applicable). These copies must be retained for a minimum statutory period of six months.

1st Copy - To be dispatched to Statistics with a copy of the Balance Chart (if applicable).

2nd Copy - To be carried on the aircraft to which it refers, on multisector flights only with a copy of the Balance Chart (if applicable).

3rd Copy - To be handed to the aircraft Captain.

NOTE: For aircraft returning to the ramp and subsequently making a second departure (including when a change of aircraft is made), a copy of the Loadsheet for each of the departures must be retained on file. According to circumstances, the Loadsheet for the first departure, whether or not the aircraft actually took off, may be called for by Inspector of Accidents to support an inquiry or investigation.

3. ACCURACY STANDARDS

Transit Stations may carry forward load details from the previous Station's Loadsheet, but must check information with the incoming Load Message to avoid repetition of errors. If an error in the Traffic Load is apparent, the appropriate cross checks must be made to locate the error.

4. LOADSHEET COMPLETION

Detailed completion instructions are contained in Ground Operations Manual Instruction C/7.

The following summary is included to enable loadsheets to be prepared at stations where staff are unfamiliar with British Airways Loadsheet procedures, or have no access to the Ground Operations Manual, e.g. diversion to an off-line station.

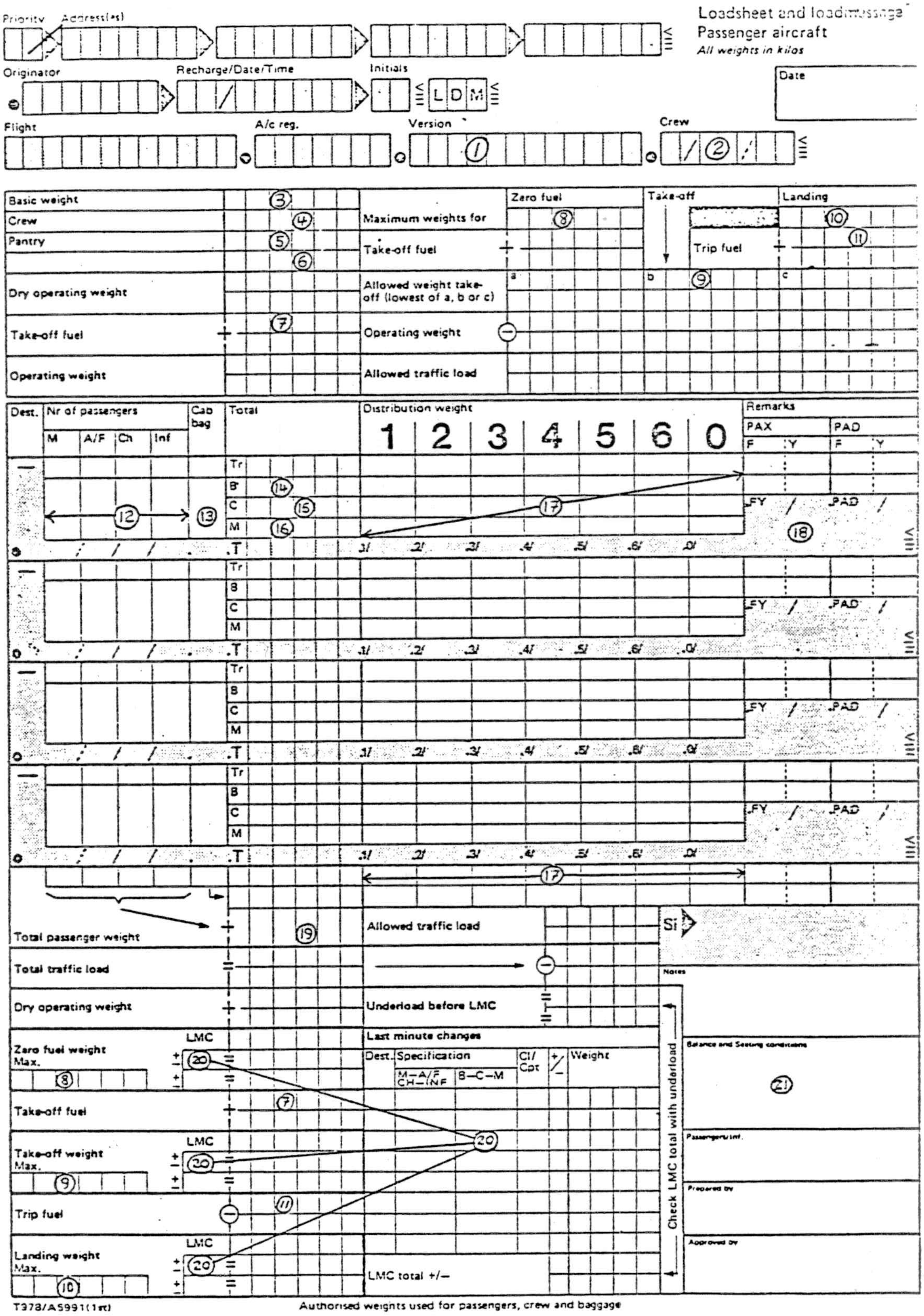
The aircraft trim is calculated on the appropriate Balance Chart. See Chater 6.

LOADSHEET COMPLETION (Continued)

Refer to numbered key on opposite page

1	VERSION	From Table 01-03
2	CREW	Flight Deck Crew/Cabin Crew (Cabin Crew may be shown as one figure or split Male/Female if required).
* 3	BASIC WEIGHT	From Aircraft Weight Schedule Extract For Adjustments see 05-04, 05-05, 05-06
* 4	CREW WEIGHT	Form 01-03
* 5	PANTRY WEIGHT	Alpha Code from Capacity Allocations (Reservations Manual). Weight from 01-03. In case of diversions etc, where no catering equipment changes take place, use weight from arrival loadsheet.
6	BLANK LINE	Not used on Super 1-11.
7	TAKE OFF FUEL	Total fuel less taxi fuel allowance from 01-01.
8	M.Z.F.W.	From 01-01.
9	M.T.O.W.	From 01-01 (RTOW supplied by Captain).
10	M.L.W.	From 01-01 (RLW supplied by Captain).
11	TRIP FUEL	Supplied by Captain.
12	PASSENGERS (By Destination)	Male/Female/Child/Infant or 'Adults'/Infants authorised on single-sector flights providing it does not cause a weight penalty.
13	CABIN BAGGAGE (By Destination)	Only used for large amounts of Cabin Baggage or other specially authorised items after consultation with the Captain.
14	BAGGAGE WEIGHT (By Destination)	Standard Weights authorised - see para 5. If Actual Weights used - delete appropriate words in statement at bottom of Loadsheet. Individual pieces over 25 kg - see 05-04 Specially authorised cabin-loaded Baggage, Guide Dogs and Diplomatic Mail (as per 03-06) - add ACTUAL weight of item to the Baggage weight and show in Cpt '0'.
15	CARGO (By Destination)	Include all EIC in Cargo weight and show in appropriate Cpt.
16	MAIL (By Destination)	Include Diplomatic Mail care of Captain in Mail weight and show in Cpt '0'.
17	DISTRIBUTION WEIGHT (By Destination)	Enter Load in each compartment
18	REMARKS (By Destination)	See Appendix A for list of Codes for use in LDM.
19	PASSENGER WEIGHT	Standard Weights authorised - see para 6. If Actual Weights used - delete appropriate words in statement at bottom of Loadsheet.
20	LAST MINUTE CHANGES	Fuel changes NOT permitted in LMC box. Actual Take-Off, Landing and Zero Fuel Weights must be amended when the total LMC weight change exceeds 500 kg.
21	BALANCE AND SEATING CONDITIONS	Enter passenger distribution as trimmed on Balance Chart. Include "Equivalent" passengers and exclude infants,

* If these items are unchanged from previous flight the Loadsheet and Balance Chart can commence from the Dry Operating Weight and Dry Operating Index (D.O.I. - see Boxes 22 and 23 on EDP Loadsheet).



Loadsheet and loadmessage
Passenger aircraft
All weights in kilos

Priority Address(es)

Originator Recharge/Date/Time / Initials LDM

Date

Flight A/c reg. Version ① Crew /②/

Basic weight ③			Zero fuel	Take-off	Landing
Crew ④		Maximum weights for	⑧		⑩
Pantry ⑤		Take-off fuel +		Trip fuel +	⑪
⑥					
Dry operating weight		Allowed weight take-off (lowest of a, b or c)	a	b ⑨	c
Take-off fuel + ⑦		Operating weight ⊖			
Operating weight		Allowed traffic load			

Dest.	Nr of passengers M	A/F	Ch	Inf	Cab bag	Total	Distribution weight 1	2	3	4	5	6	0	Remarks PAX F	Y	PAD F	Y
⑫					⑬	Tr B ⑭ C ⑮ M ⑯ .T	⑰							.FY / ⑱		.PAD /	
	/	/	/	.		.T	.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr B C M								.FY /		.PAD /	
	/	/	/	.		.T	.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr B C M								.FY /		.PAD /	
	/	/	/	.		.T	.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr B C M								.FY /		.PAD /	
	/	/	/	.		.T	.1/	.2/	.3/	.4/	.5/	.6/	.0/				
							⑰										

Total passenger weight + ⑲	Allowed traffic load	SI	
Total traffic load =	⊖	Notes	
Dry operating weight +	Underload before LMC =		
Zero fuel weight Max. ⑧ LMC ± ⑳ =	Last minute changes Dest. Specification M-A/F CH-INF B-C-M Cl/Cpt +/- Weight	Balance and Seating conditions ㉑	
Take-off fuel + ⑦	⑳		
Take-off weight Max. ⑨ LMC ± ⑳ =		Passengers/inf.	
Trip fuel ⊖ ⑪		Prepared by	
Landing weight Max. ⑩ LMC ± ⑳ =	LMC total +/−	Approved by	

Check LMC total with underload

T378/A5991(1st)

Authorised weights used for passengers, crew and baggage

SUPER 1-11
LOAD & BALANCE MANUAL
CUSTOMER SERVICE INSTRUCTIONS

British airways

Loadsheet and loadmessage
Passenger aircraft
All weights in kilos

Priority ☐ Address(es) ☐ ☐ ☐ ☐

Originator ● ☐ Recharge Date/Time / Initials ☐ LDM

Date: 12 MAY 79

Flight: 6A356 ● A/c reg.: GAVMH ● Version: B15A ● Crew: 2/3

			Zero fuel	Take-off	Landing
Basic weight	24100	Maximum weights for	35381	[redacted]	39000
Crew	425	Take-off fuel +	10000	Trip fuel +	6000
Pantry	570				
Dry operating weight	25095	Allowed weight take-off (lowest of a, b or c)	a 45381	b 41730	c 45000
Take-off fuel +	10000	Operating weight ⊖		35095	
Operating weight	35095	Allowed traffic load		6635	

Dest.	M	A/F	Ch	Inf	Cab bag		Total	1	2	3	4	5	6	0	Remarks PAX F	PAX Y	PAD F	PAD Y
LYS	35	25	4	2		Tr												
						B	660		660						0	64	0	0
						C	500			500					.FY /		.PAD /	
						M												
● / / / .						.T		.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr												
						B												
						C									.FY /		.PAD /	
						M												
● / / / .						.T		.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr												
						B												
						C									.FY /		.PAD /	
						M												
● / / / .						.T		.1/	.2/	.3/	.4/	.5/	.6/	.0/				
						Tr												
						B												
						C									.FY /		.PAD /	
						M												
● / / / .						.T		.1/	.2/	.3/	.4/	.5/	.6/	.0/				
	35	25	4	2			1160		660	500								

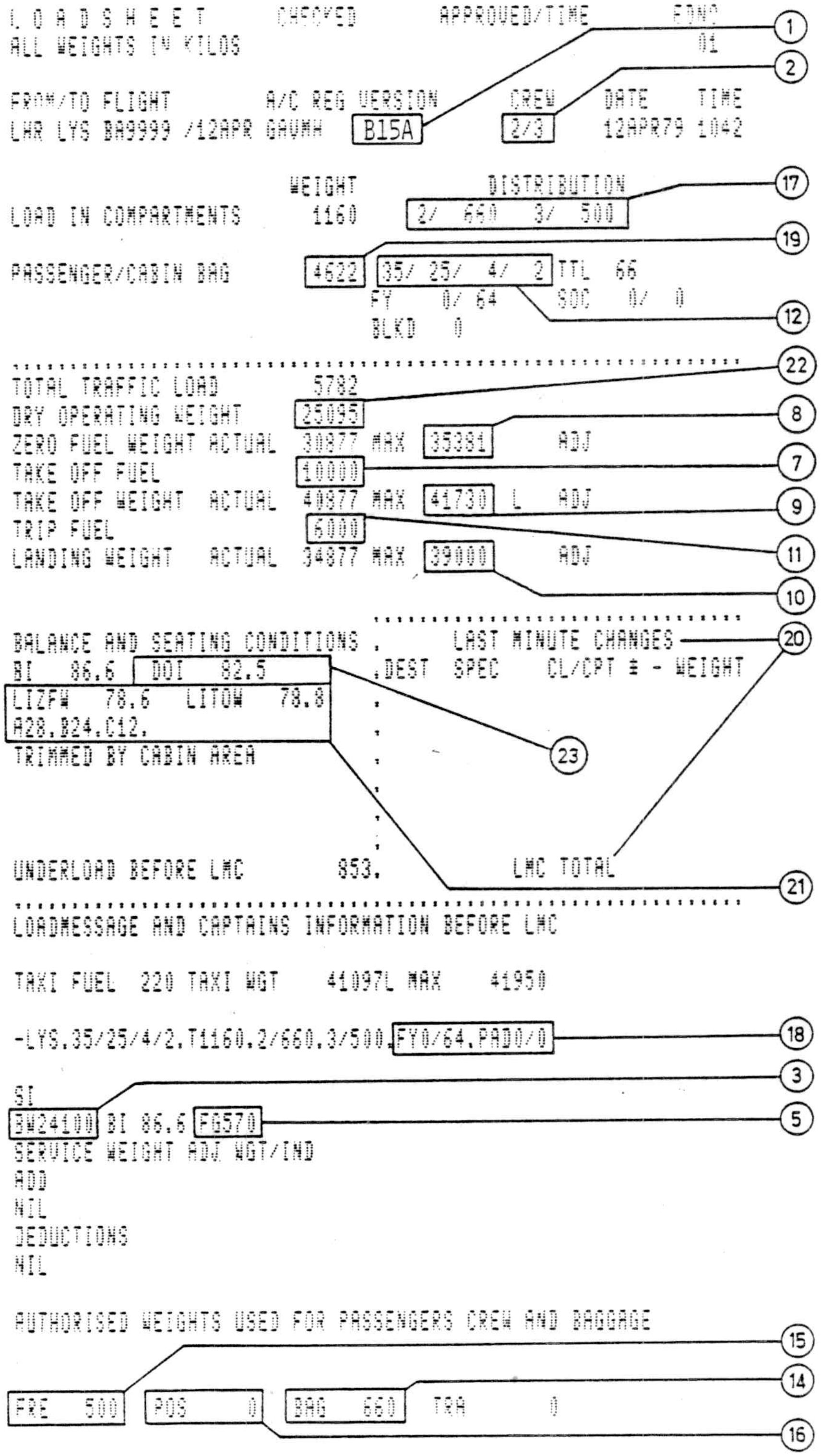
Total passenger weight	+ 4622	Allowed traffic load	6635	Si
Total traffic load	= 5782	→	⊖ 5782	Notes
Dry operating weight	+ 25095	Underload before LMC	= 853	
Zero fuel weight LMC Max. 35381	30877	Last minute changes		Balance and Seating conditions BI 86.6 LITOW 78.8 OA 28 OB 24 OC 12
Take-off fuel	+ 10000	Dest. / Specification (M-A.F CH-INF / B-C-M) / Cl/Cpt / +/– / Weight		
Take-off weight LMC Max. 41730	40877			Passengers inf 64 + 3 ints.
Trip fuel	⊖ 6000			Prepared by J Nimess
Landing weight LMC Max. 39000	34877	LMC total +/–		Approved by

Check LMC total with underload

T978/A5991(1st)

Authorised weights used for passengers, crew and baggage

EDP LOADSHEET FOR CROSS REFERENCE TO MANUAL LOADSHEET



```
L O A D S H E E T       CHECKED       APPROVED/TIME        EDNO
ALL WEIGHTS IN KILOS                                           01

FROM/TO FLIGHT          A/C REG VERSION        CREW     DATE     TIME
LHR LYS BA9999 /12APR GAUMH   B15A             2/3      12APR79  1042

                             WEIGHT              DISTRIBUTION
LOAD IN COMPARTMENTS          1160         2/  660   3/  500

PASSENGER/CABIN BAG          4622    35/ 25/  4/  2 TTL  66
                                     FY    0/ 64       SOC    0/  0
                                     BLKD   0

...............................................................
TOTAL TRAFFIC LOAD            5782
DRY OPERATING WEIGHT         25095
ZERO FUEL WEIGHT ACTUAL      30877 MAX  35381          ADJ
TAKE OFF FUEL                10000
TAKE OFF WEIGHT  ACTUAL      40877 MAX  41730   L      ADJ
TRIP FUEL                     6000
LANDING WEIGHT   ACTUAL      34877 MAX  39000          ADJ

                                    ..............................
BALANCE AND SEATING CONDITIONS .       LAST MINUTE CHANGES
BI    86.6     DOI    82.5         .DEST  SPEC    CL/CPT ± - WEIGHT
LIZFW    78.6    LITOW     78.8    .
A28.B24.C12.                       .
TRIMMED BY CABIN AREA              .
                                   .
                                   .
                                   .
UNDERLOAD BEFORE LMC          853.          LMC TOTAL
...............................................................
LOADMESSAGE AND CAPTAINS INFORMATION BEFORE LMC

TAXI FUEL  220 TAXI WGT    41097L MAX    41950

-LYS.35/25/4/2.T1160.2/660.3/500.FY0/64.PAD0/0

SI
BW24100 BI 86.6 FG570
SERVICE WEIGHT ADJ WGT/IND
ADD
NIL
DEDUCTIONS
NIL

AUTHORISED WEIGHTS USED FOR PASSENGERS CREW AND BAGGAGE

FRE    500   POS       0   BAG    660   TRA       0
```

5. STANDARD BAGGAGE WEIGHTS

(Standard Instruction - Ground Operations Manual C/10)

__10 kg per piece__: Permitted for use on publicly scheduled flights:

a) Operating entirely within the United Kingdom, excepting those to and from Jersey (and Guernsey).

b) Operating between the United Kingdom and the Republic of Ireland, excepting those to and from Shannon.

c) Operating entirely within Germany, (excepting flights from Munich).

__12 kg per piece__: Permitted for use on publicly scheduled flights.

a) Operating entirely within Europe.

b) Operating to and from Jersey (and Guernsey).

c) Operating to and from Shannon.

d) Operating between Europe and Tel Aviv.

e) Operating from Munich to destinations within Germany.

Note: See Ground Operations Manual C/10 for authority to use 12 kg per bag on UK 'Domestic' sectors of International through flights if desired.

__13 kg per piece__: Permitted for use:

a) On Shorthaul flights operating only for the carriage of 'INCLUSIVE TOUR' passengers.

b) 'SOLE-USE' Charters within Europe, subject to the conditions in Ground Operations Manual Instruction C/10 para 2.3.2

__14 kg per piece__: Permitted for use:

a) On Publicly scheduled and Inclusive Tour Intercontinental Flights.

Note: See Ground Operations Manual C/10 for authority to use 14 kg per bag on UK "Domestic" or "European" sectors of Intercontinental through flights if desired.

6. STANDARD PASSENGER WEIGHTS

(Standard Instruction - Ground Operations Manual C/10)

Male = 78 kg   Female = 68 kg   Child = 43 kg   Infant = 10 kg

78 kg may be used for all "seat-occupying" passengers (Male, Female & Child) if required.

APPENDIX A

CODES FOR USE ON LOADSHEET/LDM

EACH CODE MUST BE PRECEDED BY A FULL STOP, e.g. .AVI/1

AOG - Spare parts required for aircraft on the ground; followed by the Compartment e.g. .AOG/2.

AVI - Livestock; followed by the Compartment, e.g. .AVI/1.

BAL - Ballast; followed by the Compartment and weight, e.g. .BAL/2/250

BED - Stretcher case installed; followed by the total number of seats blocked by the stretcher arrangement and separated by an oblique the number of passengers (invalid and accompanying) and class, travelling on these seats. These passengers must be included in the PAX FY distribution, e.g. .BED/6/1Y.

COM - Company Mail: followed by the Compartment, e.g. .COM/1

DIP - Diplomatic Mail care of the Captain; followed by the number of bags, e.g. .DIP/1

EIC - Equipment in Compartments; followed by the Compartment and weight, e.g. .EIC/3/200.

FIL - Undeveloped Film; followed by the Compartment, e.g. .FIL/2

FRG - Unbooked non-revenue cargo; followed by the Compartment and weight e.g. .FRG/4/20.

FY - First, Economy Class; followed by the number of seat occupying passenger(s) per class. 1-3 numeric per class. Figure group of each class to be separated by an oblique. e.g. .FY0/47.

HEA - Heavy cargo above 150 kg per piece; followed by the Compartment and weight, e.g. .HEA/2/385. Two or more heavy pieces in the same compartment need to be shown individually, e.g. .HEA/2/196 .HEA/2/204.

HUM - Human remains in coffins; followed by the Compartment and weight, e.g. .HUM/1/158

ICE - Dry Ice; followed by the Compartment, e.g. .ICE/4.

MAG - Magnetic Materials; followed by the Compartment and weight (magnetised material label), e.g. .MAG/4/290.

NIL - No items loaded for that destination.

PAD - Indicating the number of Rebate passengers not entitled to a firm reservation and the number of seats occupied by class. Figure group of each class to be separated by an oblique. Sequence of classes as for FY. PAD are included in the PAX FY distribution. e.g. .PAD0/4.

PER - Perishables; followed by the Compartment, e.g. .PER/2.

RCM - Corrosive Materials; followed by the Compartment and weight, e.g. .RCM/1/8.

/Cont'd. ...

RCO - Combustible Liquid; followed by the Compartment and weight, e.g. .RCO/1/5.

RET - Etiological Agent; followed by the Compartment and weight, e.g. .RET/2/20

REX - Explosives; followed by the Compartment and weight, e.g. .REX/1/24.

RFL - Flammable Liquids; followed by the Compartment and weight, e.g. .RFL/2/15.

RFG - Flammable Compressed Gases; followed by the Compartment and weight, e.g. .RFG/2/10

RFS - Flammable Solids; followed by the Compartment and weight, e.g. .RFS/1/2.

RFW - Flammable Solids (Water Reactive Materials, Solids); followed by the Compartment and weight, e.g. .RFW/1/10.

RIM - Irritating Material; followed by the Compartment and weight, e.g. .RIM/1/10.

RNG - Non-flammable Compressed Gases; followed by the Compartment and weight, e.g. .RNG/1/20.

ROX - Oxidising Materials (except organic peroxides); followed by the Compartment and weight, e.g. .ROX/1/10.

ROP - Oxidising Materials (organic peroxides only): followed by the Compartment and weight, e.g. .ROP/1/10.

RPB - Poisonous Articles (Class B Poisons); followed by the Compartment and weight, e.g. .RPB/1/30.

RRY - Radioactive Materials (yellow label) Categories II and III followed by the Compartment and number of Transport Indexes. e.g. .RRY/1/3.

SEC - Security item; followed by Compartment and number of items, e.g. .SEC/2/4.

SOC - Seats occupied by Baggage, cargo and/or mail; followed by the number of seats occupied. Figure group of each class to be separated by an oblique (Sequence of classes FY). SOC not included in PAX FY distribution, e.g. .SOC/0/9.

XCR - Operating crew occupying passenger seat when no crew seat available; followed by the number of seats by class. Figure group of each class to be separated by an oblique. XCR not included in the PAX FY distribution, e.g. .XCR/0/4.

GENERAL & DESCRIPTION

1. GENERAL

	Version Code	Balance Chart
99 Seater (99Y)	B15A	BS1/1
99 Seater (99Y) SHUTTLE	B5SA	BS1/2

2. DESCRIPTION OF BALANCE CHART BS1/1

The Balance Chart consists essentially of a series of scales placed horizontally one below the other.

The top scale is for the Dry Operating Index, which represents the combined moment corresponding to the British Airways Basic condition plus crew, catering and any adjustments to the Basic condition. The remaining scales cover all other items of disposable load except fuel. The scales are calibrated in divisions, each division representing the moment corresponding to the weight or quantity shown on the arrow associated with each scale. The arrow indicates the effect of the moment, i.e. the direction in which it should be added.

The trim diagram shows the safe area with two aft limits, one 'Normal' and one 'No Passengers'. The 'No Passengers' aft limit may only be used when no payload is carried in the cabin, e.g. ferry flights.

A fuel table below the trim diagram shows the index correction for various quantities of fuel.

3. DESCRIPTION OF BALANCE CHART BS1/2 (used for 'Shuttle' only)

BS1/2 combines the Loadsheet and Balance Chart functions on to one piece of paper.

The Loadsheet functions are fully described in the Ground Operations Manual Section C/7.

The Balance Chart consists essentially of a series of scales placed horizontally one below the other.

The top scale is for the Dry Operating Index, which represents the combined moment corresponding to the British Airways Basic condition plus crew, catering and any adjustments to the Basic condition. The remaining scales cover all other items of disposable load except fuel. The scales are calibrated in divisions, each division representing the moment corresponding to the weight or quantity shown on the arrow associated with each scale. The arrow indicates the effect of the moment, i.e. the direction in which it should be added

The trim diagram shows the safe area with two aft limits, one 'Normal' and one 'No Passengers'. Whenever passengers are carried their distribution must comply with the Seating Conditions given below the trim diagram on the Chart and the 'Normal' aft limit must be used. The 'No Passenger' aft limit may only be used when no payload is carried in the cabin, e.g. ferry flights.

A fuel table below the trim diagram shows the index correction for various quantities of fuel.

USE OF CHARTS

1. USE OF BALANCE CHART BS1/1 AND BS1/2

(1) Refer to the Weight Schedule Extract of the aircraft to be loaded and obtain the Basic Index. Enter this value in the box provided.

(2) Add the indices for Crew, Catering and any adjustments to the Basic condition to obtain the Dry Operating Index.

(3) Enter the Dry Operating Index scale at this value and draw a line vertically down on to the first applicable scale below.

(4) Lay off the appropriate amount on this scale, in the direction indicated by the arrow.

(5) Repeat this process of descending vertically from scale to scale laying off on each the appropriate amount in the correct direction, until all passengers have been trimmed.

(6) Draw a line vertically down from the last scale through the trim diagram. Mark on it the Zero Fuel Weight. Redistribute the load if necessary so that this point lies within the safe area. Enter the Laden Index Zero Fuel Weight (LIZFW) value in the box to the left of the trim diagram.

(7) From the Fuel table below the trim diagram obtain the Fuel Index correction value. For weight values in between those quoted use the nearest figure e.g. 8500 kg is +0.5. Enter the appropriate Index value in the Fuel Index box. Complete the sum to obtain the Laden Index Take-Off Weight (LITOW) value.

(8) Draw another trace down into the trim diagram at the LITOW value.

(9) Mark on it the Take-Off Weight. Redistribute the load if necessary so that this point lies within the T.O.W. safe area. If redistribution of load is necessary, then the Zero Fuel Weight must be checked, and amended if necessary.

ADDITIONAL INFORMATION

1. 'EQUIVALENT' PASSENGERS (DEADLOAD IN PASSENGER CABIN)

If the total deadload in the cabin area is 35 kg or less, no Balance Chart action is required.

If greater than 35 kg, then the deadload carried in the cabin area must be converted into 'equivalent' passengers by dividing the weight by 78 kg. If the number is not exactly divisible by 78 kg then the fraction over should be counted as one, e.g. 130 kg gives 2 'equivalent' passengers.

A. When using Balance Chart BS1/1

Divide the total weight in each cabin area by 78 kg, e.g. 130 kg in Row 1 gives 2 'equivalent' passengers in Cabin Area OA.

B. When using Balance Chart BS1/2 ('Shuttle' only)

Divide the total weight in the cabin by 78 kg to obtain the total number of 'equivalent' passengers to be entered on the Chart. Inform the Cabin Crew of the number and position of the 'equivalent' passengers so that they are accounted for when checking that the Seating Conditions have been met.

NOTE: Any reference to passengers in Chapter 6 is to be interpreted as including 'equivale' passengers.

BALANCE CHART ALTERATION

1. ADDITIONS AND DEDUCTIONS INDEX TABLE

This table gives the index correction required for specified increments of load in KG added or deducted in various parts of the aircraft.

For weight ADDITIONS use the signs (i.e + or −) on the left, for DEDUCTIONS use the signs on the right.

ADDITIONS	LOCATION	WEIGHT - KG							DEDUCTIONS
		20	30	40	50	65	75	100	
	FLIGHT DECK	0.1	0.2	0.2	0.3	0.3	0.4	0.5	
	FWD CABIN CREW SEAT	0.1	0.1	0.2	0.2	0.3	0.3	0.4	
—	FWD PANTRY	0.1	0.1	0.2	0.2	0.3	0.3	0.5	+
	COMPARTMENT 1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	
	COMPARTMENT 2	NIL	0.1	0.1	0.1	0.1	0.1	0.2	
	CABIN AREA OA	0.1	0.1	0.1	0.1	0.2	0.2	0.3	
	CABIN AREA OB	NIL							
	COMPARTMENT 3	NIL		0.1	0.1	0.1	0.1	0.1	
+	COMPARTMENT 4	0.1	0.1	0.1	0.1	0.2	0.2	0.3	—
	CABIN AREA OC	NIL	0.1	0.1	0.1	0.1	0.1	0.2	

Example: Add 30 kg in FWD PANTRY
Index change −0.1

2. LAST MINUTE CHANGE (L.M.C.)

If the resultant index change of all L.M.C's is not greater than ± 0.5 Index Units then no Balance Chart action is required.

British airways

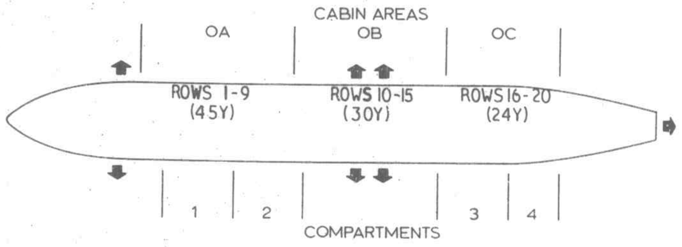
BAC SUPER 1-11

STANDARD BALANCE CHART

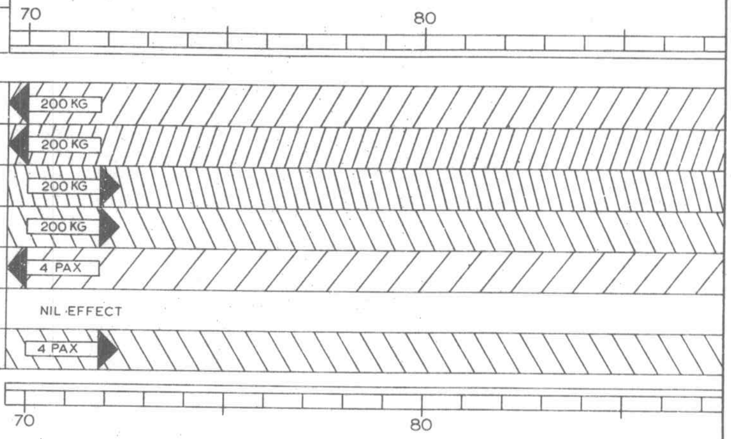
No. **BS1/1**

FL. No.	DATE	A/C REG.	APT.	CAPT.

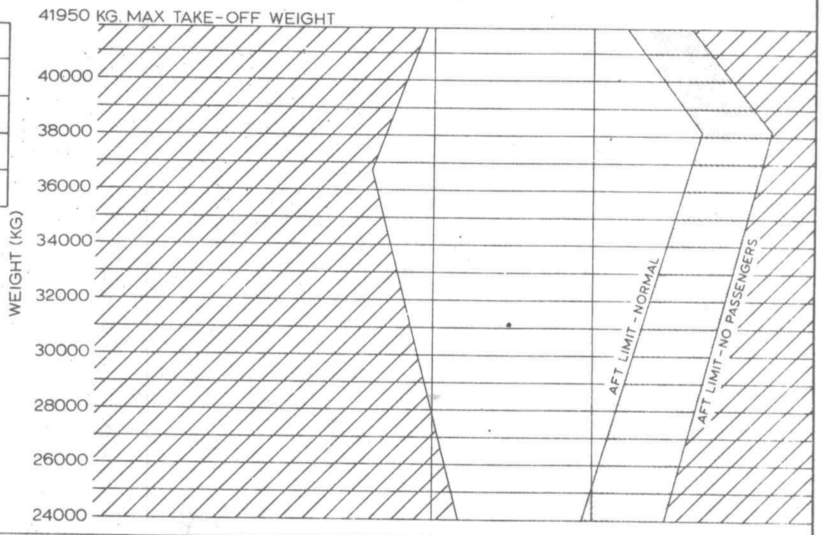
	−	+
BASIC INDEX	☒	.
CREW	.	☒
CATERING	.	☒
	.	.
TOTALS	.	.
DRY OPERATING INDEX		.



COMPARTMENT 1	MAX 1990	
COMPARTMENT 2	MAX 1980	
COMPARTMENT 3	MAX 1860	
COMPARTMENT 4	MAX 860	
CABIN AREA OA		
CABIN AREA OB		
CABIN AREA OC		



LIZFW		.	
FUEL INDEX	− +		
LITOW		.	



FUEL

WT-KG	INDEX	WT-KG	INDEX	WT-KG	INDEX	WT-KG	INDEX	WT-KG	INDEX
2000	−0·1	4000	+0·1	6000	+0·5	8000	+0·6	10000	+0·2
3000	−0·1	5000	+0·3	7000	+0·6	9000	+0·5	11160	NIL

FOR CAPTAINS USE ONLY

CREW INDEX EFFECT			CATERING INDEX EFFECT
	2+2	−1·1	−0·5 / 100KG
	2+3	−1·4	
	3+2	−1·5	
	3+3	−1·9	

Prepared by:

V300 (IST)

British airways Shuttle

SUPER 1-11
99 SEATS

LOADSHEET / BALANCE CHART and load message

No. **BS1/2**

Address	Originator	Date

From		Flight	A/C Req	Version	Crew	Notes
	LDM	BA____	G-AVM__	B5SA	/	

REVENUE	
AD	
CH	
S/BY	
STAFF	

all weights in kilos

BASIC WEIGHT	
Crew ( )( )	
Catering Fwd	
DRY OPERATING WEIGHT	

FOR CAPTAINS USE ONLY			
CREW INDEX EFFECT	2+2	-1·1	CATERING INDEX EFFECT 0·5/100 KG
	2+3	-1·4	
	3+2	-1·5	
	3+3	-1·9	

BASIC INDEX	
Crew	
Catering Fwd	
TOTALS	
DRY OPERATING INDEX	

	1	2	3	4	Cabin
Max	1990KG	1980KG	1860KG	860KG	*

* SEE LOAD & BALANCE MANUAL

Cargo	
Mail	
Eic	
Total	

(a)

Pieces of baggage (b)

M	F	Ch	Inf

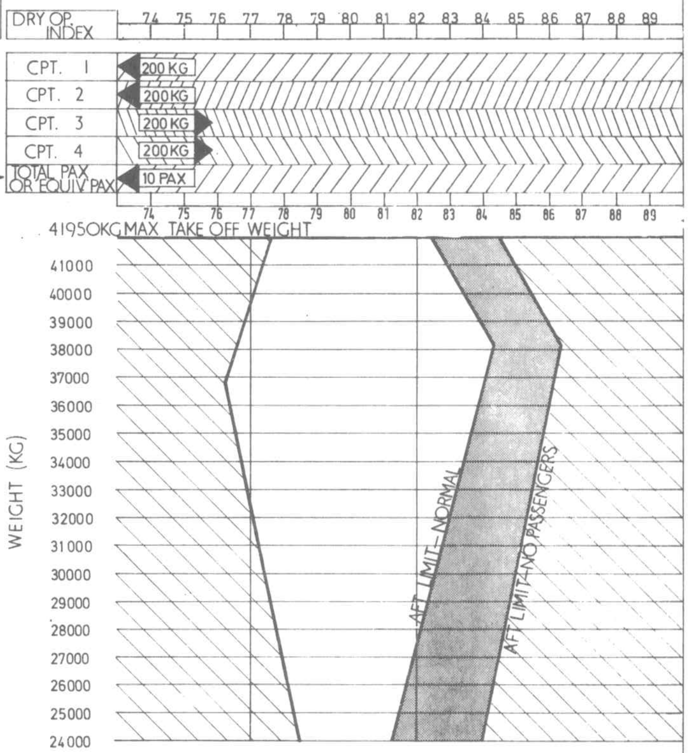
(c)

Cabin baggage (d)

TOTAL TRAFFIC LOAD (a)+(b)+(c)+(d)	=	
Dry Operating Weight	+	
ZERO FUEL WEIGHT Max 3 5 3 8 1	=	
Take-off fuel	+	
TAKE-OFF WEIGHT	=	
Trip fuel	⊖	
LANDING WEIGHT Max	=	

Allowed Traffic Load	
Actual	
Under-loaded before LMCs	

			Inf
Pax			
Equiv. Pax			
TOTAL			



Last Minute Changes

Specification	Cpt	+/–	Weight
LMC total +/–			

Check with underloaded

FUEL			
WT KG	INDEX	WT KG	INDEX
2000	-0·1	7000	+0·6
3000	-0·1	8000	+0·6
4000	+0·1	9000	+0·5
5000	+0·3	10000	+0·2
6000	+0·5	11000	NIL

PASSENGERS AND EQUIVALENT PASSENGERS	SEATING CONDITIONS
1—99	THE NUMBER IN ROWS 1-4 MUST EXCEED THE NUMBER IN ROWS 17-20 BY AT LEAST 1 BUT NOT MORE THAN 5

PREPARED BY	CAPTAINS SIGNATURE

V304

AUTHORISED WEIGHTS USED FOR PASSENGERS, CREW AND BAGGAGE